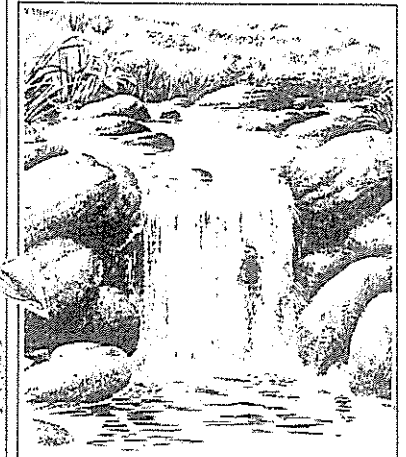
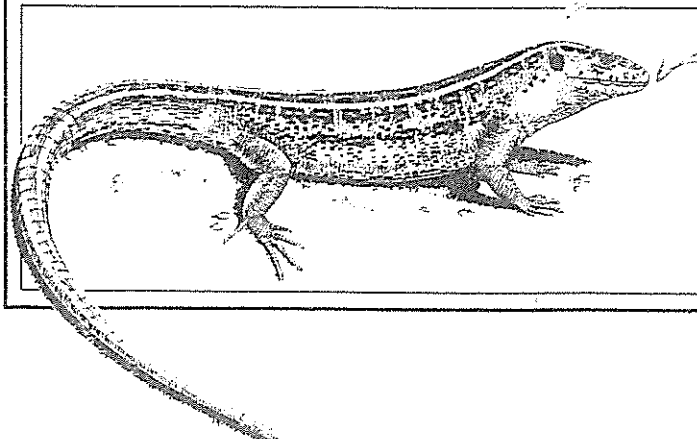
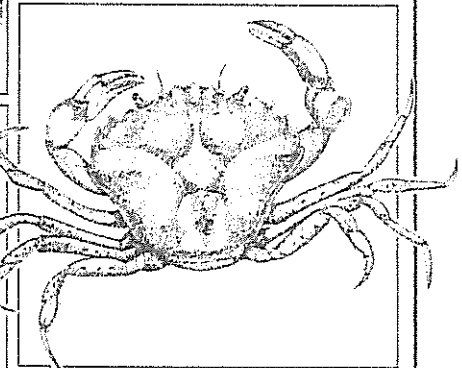
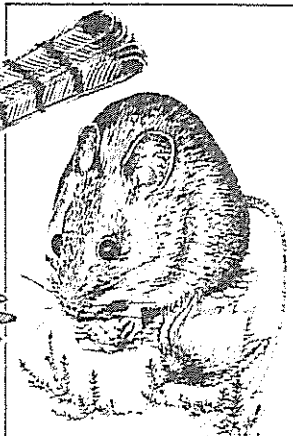
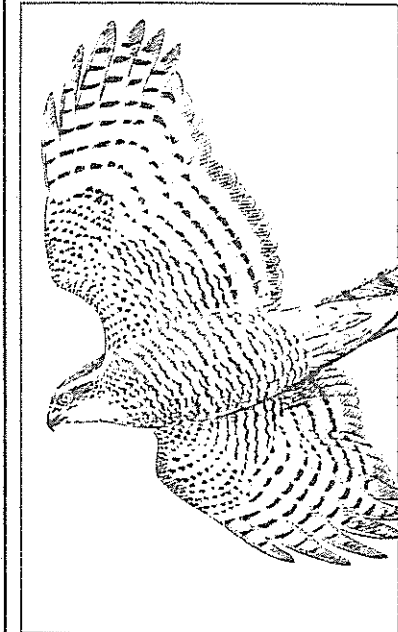


Research & survey in nature conservation

No. 26

Dungeness:
a vegetation survey
of a shingle beach



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of a shingle beach

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NCC coastal ecology research programme

The Coastal Ecology Branch of the Chief Scientist Directorate was established in August 1987. One of the functions of the branch is to co-ordinate research and survey in the field of terrestrial coastal conservation. To this end a research programme has been developed with four main aims:

- 1 to describe the size, location and quality of the main coastal habitats in Great Britain (saltmarshes, sand-dunes, vegetated shingle, sea-cliffs, strandlines, 'reclaimed' land and maritime islands);
- 2 to assess the impact of major development projects on sites of national importance for nature conservation;
- 3 to provide guidance on the management of the main coastal habitats for nature conservation;
- 4 to investigate the role of physical and biological processes in the maintenance of natural and semi-natural coastal habitats.

The results are disseminated in various NCC publications:

- a CSD research reports: limited numbers of 'hard' copies are produced, usually by the contractor, and the contents are later made available as a CSD report on microfiche through NCC's Information and Library Services;
- b "Contract surveys";
- c "Research & survey in nature conservation";
- d "Focus on nature conservation".

This report represents one of the "Research & survey in nature conservation" series. It is designed principally to provide a thorough review of surviving shingle vegetation at Dungeness, together with changes which have resulted from the impact of major and other development projects. It also forms part of the Great Britain-wide survey of shingle vegetation (see 1 above). Detailed vegetation maps (1:2,500), with an accompanying report, have been produced under a separate contract for the Nature Conservancy Council by Dr R. M. Fuller (see Bibliography).

The authors wish to acknowledge the co-operation given by the various landowners at Dungeness, especially the R.S.P.B., the M.O.D., the C.E.G.B., the Folkestone and District Water Company and the Lydd Airport Authority, during this investigation.

Dr Pat Doody
Head, Coastal Ecology Branch
Nature Conservancy Council
Peterborough

1 INTRODUCTION

The earliest detailed account of the vegetation of the Dungeness shingle appears to be that of Rosa (1953), an unpublished report for the Nature Conservancy. This record comprised species lists for 34 sites, most of them directly on the shingle, with accompanying estimates of species frequency based on the DAFOR scale. The survey was carried out as a prelude to notification by the Nature Conservancy of the Dungeness S.S.S.I. in 1951, and served to emphasize the ecological importance of the area.

In 1965, Scott published an account of the shingle vegetation, with particular emphasis on successional relationships. He described the sequence from bare shingle, with only encrusting lichens, to subsequent colonization by Cytisus scoparius, and then later the establishment of heath vegetation in which various species, including mosses and lichens, were present. Scott was the first to emphasize the importance of humic soil generation, particularly by Cytisus scoparius, in the succession. He was also of the opinion that various forms of scrub, of Ulex europaeus, Sambucus nigra, Prunus spinosa and Ilex aquifolium, probably represented the natural climax of the succession. Curiously, Scott did not record the pioneer seral stages, dominated by Crambe maritima and Arrhenatherum elatius, which occur on the younger, east coast ridges.

Two later papers, Hubbard (1970) and Peterken & Hubbard (1972), were also concerned with ecological succession. In the former paper, Hubbard provided a more complete picture of the early seral stages of the shingle succession, and Peterken & Hubbard (1972) summarized their combined views on the shingle succession in the context of studies of the Holmstone Beach holly wood. Their model of succession incorporated early pioneer

stages dominated by Crambe maritima and a mixture of Festuca rubra and Arrhenatherum elatius, in addition to those mentioned by Scott. Hubbard (1972) also described the full range of habitats, some, such as freshwater and saltmarsh, associated with, but not occurring directly on, the shingle. He further mentioned the effects of grazing by domestic stock and by rabbits, and the impact of man (disturbance of the shingle surface, excavation of gravel and the introduction of foreign material into the shingle substratum) on the vegetation.

It is noteworthy that all of the authors mentioned above referred to the gradual erosion of the ecological quality of Dungeness, and emphasized the need to publish records of the vegetation, especially of areas likely to be lost to building development or gravel excavation.

The establishment of the first nuclear power station at Dungeness, 'A station', in the early 1960s was a major impetus to the publishing of Scott's paper. In 1984 the Central Electricity Generating Board commissioned a vegetation survey of the shingle landscape surrounding the C.E.G.B. compound (by now enclosing 'A station', 'B station' and associated space and buildings), and, since this area included a large part of the Royal Society for the Protection of Birds reserve, the survey was carried out by R.S.P.B. ecologists (Smith 1984). An important part of this survey comprised the production of a series of vegetation maps (1:2,000) of the designated study area, in which some 20 major and minor variants of plant communities, all directly shingle-based, were included. In 1969-70 Hubbard had in fact mapped the same area, using 11 vegetational variants, of which five were directly shingle-based. Smith was able to use Hubbard's maps as a baseline for her own survey. Smith's communities were defined by means of percentage frequency data, based on large numbers of replicate quadrats (100 to 3,100 depending on the abundance or scarcity of the

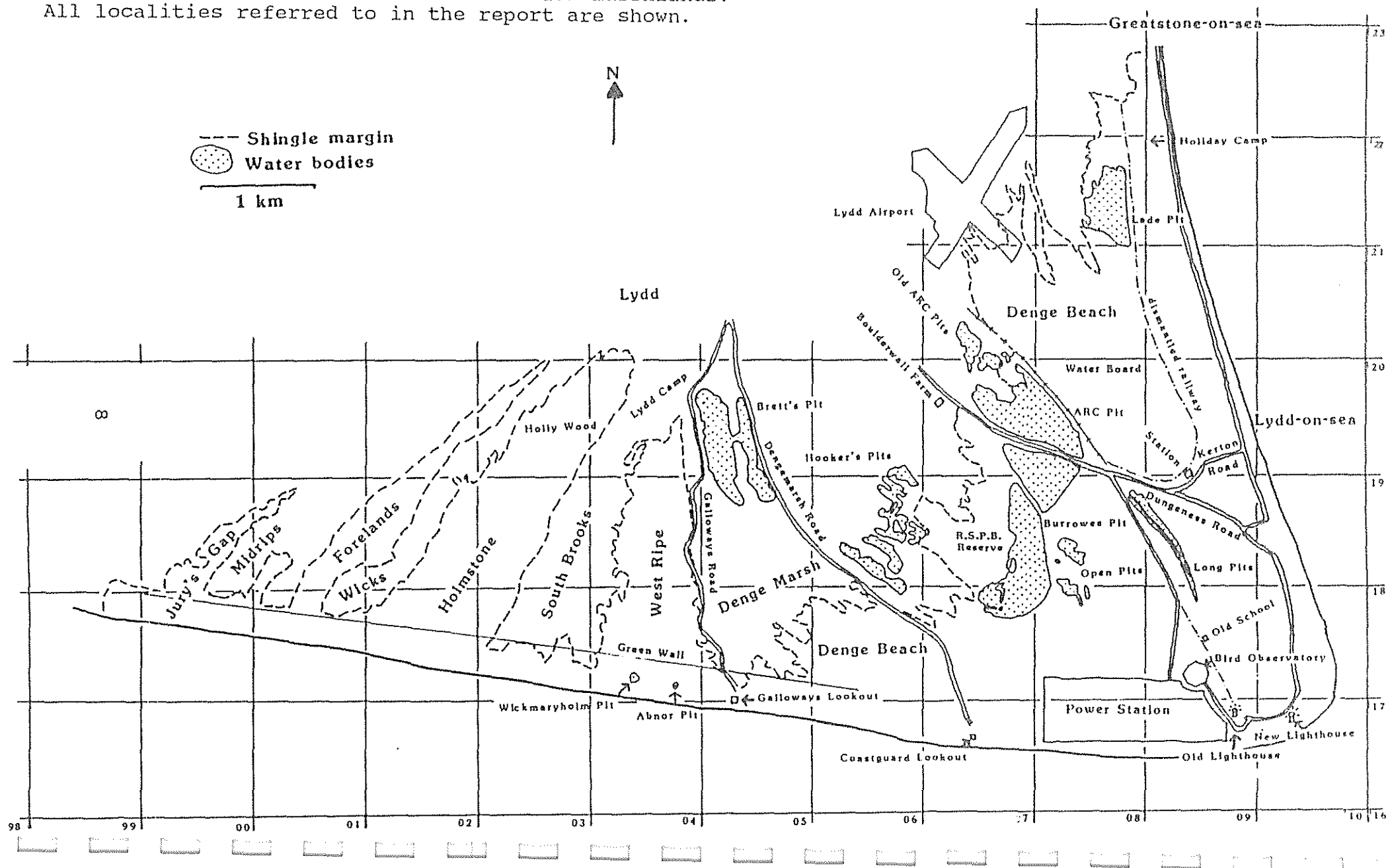
community concerned). In addition the communities were categorized as pioneer, mature or inland mature. Some possible seral interrelationships between pioneer and mature communities were suggested, but no overall model of succession was generated.

In 1983, in order to produce a site survey file relating to the Dungeness S.S.S.I., the Nature Conservancy Council (N.C.C.) commissioned the production of a report on the vegetation of Dungeness (Henderson 1983). The author classified the full range of habitats occurring within the Dungeness S.S.S.I. under 21 categories, and also mapped these at a scale of 1:10,000. Of these only category A (wholly) and categories B, F and N (in part) occurred directly on the shingle, and the vegetation categories were not defined according to National Vegetation Classification (N.V.C.) methods (Rodwell 1980).

The last few years have seen the publication of further papers which have dealt mainly with the shingle succession (Ferry & Barlow 1985; Barlow 1989; Ferry, Barlow & Waters 1989). These differed significantly from earlier publications and reports in that modern analytical methods, notably ordination and classification, were used to process quantitative data, which together with measurements of abiotic variables (substrate texture and pH) were used to generate successional models. The most recent publication (Ferry, Barlow & Waters 1989) attempts to incorporate man-made and man-modified habitats, now over-abundant at Dungeness, into the scheme of things and uses N.V.C. methodology.

The present study was commissioned by the N.C.C. in 1987, once again against a background of continuing and in some cases intensifying pressures on the Dungeness S.S.S.I., to provide a detailed account of the vegetation

FIGURE 1. Map of Dungeness showing the shingle beaches and associated areas of reclaimed alluvial marshlands. All localities referred to in the report are shown.



of the whole of the Dungeness shingle. The aims were twofold - to provide a classification of the shingle communities of Dungeness, based on the N.V.C. scheme adopted by the N.C.C. for use in the British Isles, and to provide a sufficiently detailed classification for use in field mapping of the vegetation. Dr Robin Fuller of the Institute of Terrestrial Ecology, Monks Wood, has been separately contracted by the N.C.C. to produce final corrected versions of the maps at a scale of 1:2,500. These include the full range of vegetation types recognized in the field survey and estimates of areas presently occupied by these (Fuller 1989).

2 SITE

The study site comprised all the surface shingle in the triangle from Jury's Gap to Greatstone and down to the Dungeness Point (see Figure 1).

3 METHODS

3.1 Vegetation classification

As a preliminary to the mapping exercise, the shingle ridge vegetation was described according to the methods adopted by the National Vegetation Classification project (Rodwell 1980).

3.1.1 Field description

Quadrat samples were located wholly within stands of vegetation judged by eye to be floristically and structurally homogeneous. Thus vegetation boundaries and communities which included atypical vegetation

features were avoided. Samples were delimited from the surrounding vegetation by means of a simple frame of pins and string. Generally, a rectangular sample 2 m x 4 m could be fitted into the patch of vegetation being described. In a few instances, mainly adjacent to roads or paths, a 1 m x 4 m strip had to suffice, whilst in the case of the four quadrats from Holmstone Beach, individual clumps of holly Ilex aquifolium were treated as the sample. Samples were individually numbered and their location carefully noted on the photocopied enlargements of aerial photographs (see p. 13).

Within each quadrat all the vascular plants, bryophytes and lichens (excluding crustose species on pebbles) were noted on a specially prepared sample sheet and percentage cover values assigned by eye for each. Surface shingle samples (to a depth of c. 20 cm) were then collected; these were sieved and the dry weight of the following three fractions determined:

- >1 cm
- <1 cm, >2 mm
- <2 mm.

The pH of the fine fraction (<2 mm) was also measured with an electrometric pH meter.

In total, 154 samples of vegetation were described. About two thirds of these were located in the Long Pits area of Denge Beach, since this region appeared to support many of the vegetation types of both undisturbed and disturbed shingle. Additional distinctive vegetation types, encountered elsewhere during the field mapping, were sampled and incorporated in the analysis.

3.1.2 Vegetation analysis

All percentage cover values were converted into cover/abundance ratings, using the ten-point Domin scale (sensu Dahl & Hadac 1941). Data analysis was carried out on a VAX 11/780 computer, with a version of VESPAN I (Malloch 1985) which had been modified by Dr S. Waters.

Several of the programmes in the VESPAN package are built around the analytical techniques of TWINSPAN and DECORANA written by M.O. Hill (1979a,b).

TWINSPAN is a programme designed primarily to analyse multivariate data. The programme makes a dichotomy of the principal axis of an ordination, giving two groups of samples, and then each group of samples is re-ordinated and again divided, and so on until a halt is called. When a classification of the samples has been achieved, the results are used to derive a classification of species. Finally the sample and species orders are combined into a condensed two-way table. Output is provided in a form suitable for a lineprinter, as well as in a machine-readable form which can be further processed, for example by TWINTAB, or sent to a plotter for the production of dendrograms.

TWINSPAN handles quantitative data, using the concept of 'pseudo-species' (Hill, Bunce & Shaw 1975). The idea is to introduce extra 'species' having the same name, to represent the abundance of a particular species, the number of these pseudo-species required for any one species in a stand being proportional to the abundance of the species there. Thus the pseudo-species allow a distinction to be made between samples on the basis of quantity, in a way that would not be possible using

simple presence and absence data. Of course there is a severe limit to the number of pseudo-species that can be defined, otherwise the data matrix would soon exceed the computer's memory; hence in the implementation of TWINSPAN employed in this investigation, the Domin data were reduced to a four point scale as shown below:

Domin 1 and 2	=	1
Domin 3 and 4	=	2
Domin 5 to 7	=	3
Domin 8 to 10	=	4

The machine-readable output from TWINSPAN served as input into TWINTAB which produces a phytosociological table further to clarify the sample groups defined by the former procedure. TWINTAB orders the samples according to the sequence produced by TWINSPAN. The species within each group are given appropriate constancy values. The species are also ordered according to the arrangement given by TWINSPAN, with the species groups clearly distinguished, and, if desired, a constraint can be used to place at the bottom of the table any species which were not of high constancy in any of the sample groups. A further routine, TWINTABSUM was used to produce a summary of the phytosociological table created by TWINTAB.

DECORANA is an ordination programme somewhat similar to reciprocal averaging, but where correlations between the first and higher axes have been removed, thus avoiding the 'arch effect' prevalent in many ordination techniques. Full details of DECORANA are given in Hill (1979b). The implementation used provided both sample and species ordinations, giving the scores of species or samples along the first four axes of the ordination. In addition to output suitable for printing on the lineprinter the solution was produced in machine-readable

form which could be sent directly to a plotter. The ordination plots proved to be very helpful in the interpretation of the vegetation groupings produced by TWINSPAN and TWINTAB.

3.2 Mapping

The shingle areas of Dungeness were covered by a NERC stereo air photographic survey carried out on the 28 July 1984, flown at 1:5,000 scale using a Wild RC-8 camera with 152 mm lens. Photocopied enlargements (x 1.416, linear dimension) of these photographs, supplied by Dr Robin Fuller of the Institute of Terrestrial Ecology, Monks Wood Experimental Station, were used as a basis for the field maps. The resolution of these enlargements was such that every patch of vegetation shown on them could readily be identified on the ground.

The entire shingle surface was systematically walked and, utilizing the vegetation categories which had resulted from the vegetation analysis, each patch of vegetation equal to or greater than 1 m across, represented on the photographs, was annotated with details of the plant community concerned.

The annotated photographs were returned to Dr Fuller who employed a Stereo Zoom Transfer Scope to correct distortions and fit details of vegetation patterns onto OS 1:2,500 maps (Fuller 1989).

4 THE RESULTS

The results of the TWINSPAN analysis are presented in Figure 2, in dendrogram form. Eleven levels of division were required to resolve the range of vegetation types recognizable in the field, reflecting the considerable

FIGURE 2. A TWINSPLAN classification of the vegetation types at Dungeness. The classification is, in reality, based on quadrats (which vary in number; see key below and Figure 3) sampled from stands of each vegetation type; for the sake of simplicity these are omitted here. The divisions in the dendrogram, viewed from left to right, are based on decreasing variation (assessed in terms of species presence/absence and quantity) in the quadrats remaining at any particular level of division. Hence, at level 1, vegetation type C separates from the remainder because of a complete non-overlap of species; at level 11, vegetation types A2 and A3 separate on the basis of very slight differences in species composition.

KEY

- A1 Cytisus scoparius/Ulex europaeus scrub
- A2 Calcifuge grassland
- A2 fragmented
Local A2 variant on western Denge Beach
- A2 Polytrichum
Local A2 variant in excavated area near Lydd Camp
- A2 Lydd Airport
Local A2 variant near Lydd Airport
- A2 Digitalis
Local A2 variant on northern Forelands
- A2S Shingle margin variant of A2 calcifuge grassland
- A2F Maritime (cliff) Festuca rubra grassland
- A3 Slightly mesotrophic form of A2 calcifuge grassland
- B1 Mesotrophic vegetation
- B2 Wetland vegetation
- B3 Arrhenatherum elatius grassland
- B3(S) Jury's Gap
Local B3 variant at Jury's Gap
- C Strandline vegetation
- E Sambucus nigra scrub
- G Geranium robertianum vegetation
- I Ilex aquifolium scrub
- P Prunus spinosa scrub

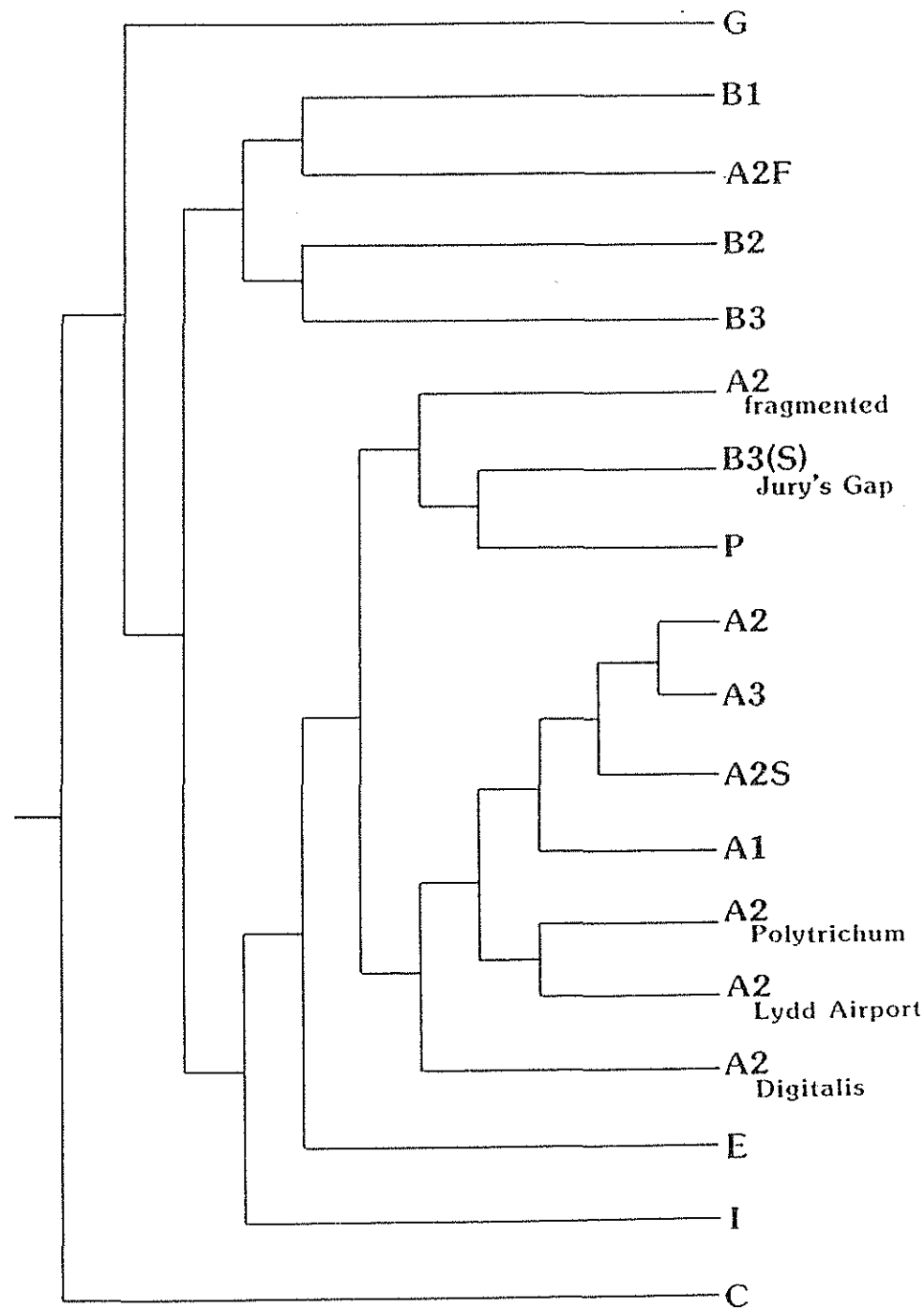


TABLE 1. Vegetation types (local codes), numbers of quadrats and species used for field identification. Species listed in bold are TWINSpan indicator species; others are TWINSpan preferential species.

Local Code	Number of Quadrats	Species
A1	8	<i>Cytisus scoparius</i> <i>Ulex europaeus</i>
A2	19	<i>Cladonia ciliata</i> <i>Dicranum scoparium</i> <i>Rumex acetosella</i> <i>Aira praecox</i> <i>Cladonia portentosa</i> <i>Coelocaulon aculeatum</i> <i>Festuca tenuifolia</i> <i>Teucrium scorodonia</i>
A3	17	as in A2 but slightly more of some or all of <i>Sedum anglicum</i> <i>Senecio jacobaea</i> <i>Teesdalia nudicaulis</i> <i>Cerastium fontanum</i> <i>Plantago lanceolata</i> <i>Poa compressa</i>
A2S	14	as in A2 but more of some or all of <i>Cladonia foliacea</i> <i>Cladonia gracilis</i> <i>Silene vulgaris</i> subsp. <i>maritima</i> <i>Cladonia rangiformis</i> <i>Sedum anglicum</i>
A2F	5	<i>Cladonia rangiformis</i> <i>Festuca rubra</i> <i>Armeria maritima</i> <i>Cerastium fontanum</i> <i>Silene vulgaris</i> subsp. <i>maritima</i>
B1	17	<i>Achillea millefolium</i> <i>Dactylis glomerata</i> <i>Festuca rubra</i> <i>Plantago lanceolata</i> <i>Poa compressa</i> <i>Senecio jacobaea</i> <i>Echium vulgare</i> <i>Medicago lupulina</i> <i>Rubus fruticosus</i>
B2	7	<i>Galium palustre</i> <i>Ranunculus repens</i> <i>Rubus fruticosus</i>
B3	17	<i>Arrhenatherum elatius</i> <i>Galium mollugo</i> <i>Rumex acetosa</i> <i>Rumex crispus</i> <i>Rubus fruticosus</i> <i>Silene vulgaris</i> subsp. <i>maritima</i> <i>Vicia hirsuta</i> <i>Vicia sativa</i>
C	11	<i>Atriplex glabriuscula</i> <i>Crambe maritima</i>
G	4	<i>Geranium robertianum</i>
I	4	<i>Ilex aquifolium</i>
E	6	<i>Sambucus nigra</i>
P	5	<i>Prunus spinosa</i>

A2 excludes 16 quadrats labelled as variants of A2 in Figure 3;
B3 excludes 4 quadrats labelled B3(S) in Figure 3.

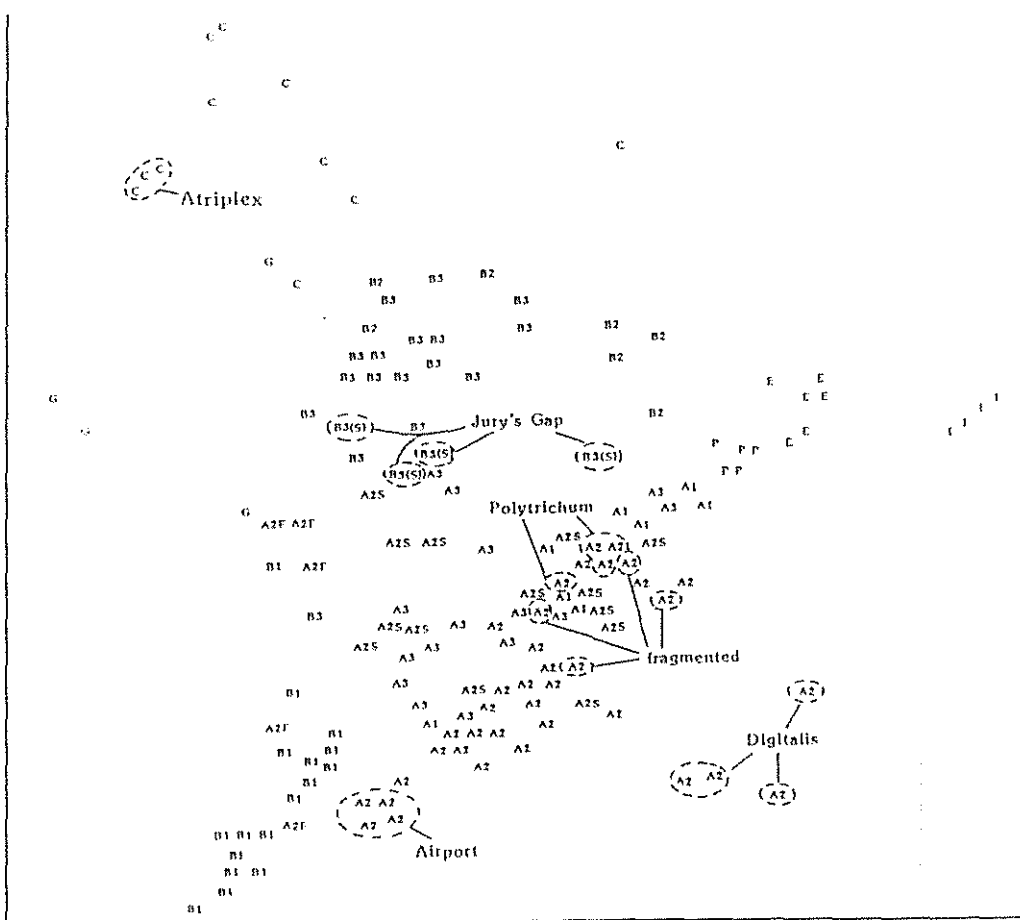
diversity of vegetation on the Dungeness shingle. The finer divisions are between the different variants of the calcifuge grassland, e.g. A2, A2S and A3.

The codes applied to each vegetation type in Figure 2, e.g. A1, A2 etc., are local Dungeness codes, as used throughout this report and by Fuller (1989). Table 1 lists those species which were found to be particularly helpful in identifying vegetation types during the field mapping exercise. Most important amongst these are the so-called indicator species selected by the TWINSpan programme to make the dendrogram divisions in Figure 2. Other species listed are the most useful of the preferential species selected by the TWINSpan programme.

Ordination, using DECORANA, of the same data set of quadrats produced the results given in Figure 3. Quadrats belonging to a common vegetation type, as defined by TWINSpan, can be identified. The compactness of some groups of quadrats and the relative spread of others, and the placement of groups with respect to each other, give clear indications of their inter-relationships.

A synopsis of vegetation types at Dungeness, under local codes and with suggested equivalent N.V.C. categories, is given in Table 2. Vegetation types are placed, as far as is possible, into existing N.V.C. communities and sub-communities, by comparing relevé lists (Appendix 1). For this purpose, unpublished editions of N.V.C. chapters were used (see References). In some instances only rather general affinities can be offered, and clearly some vegetation types at Dungeness are not currently recognized in the N.V.C. scheme, at least at sub-community level.

FIGURE 7. A DECORANA ordination of the quadrats and stands of each vegetation type. Each quadrat is indicated by a local vegetation type code (see key below). The relative positions of the quadrats on the scatter diagram indicate their similarities or dissimilarities (based on species presence or absence and quantity). Hence, quadrats of vegetation type B, which show no significant species overlap with other quadrats, form a discrete, isolated group; quadrats of the range of A2 variants, which contain many species in common, occur close together or even intermingled. It should be noted that, of the four axes of ordination routinely generated by DECORANA, only axes one and two are used to generate this plot.



KEY

- A1 Cytisus scoparius/Ulex europaeus scrub
- A2 Calcifuge grassland
- A2 fragmented
Local A2 variant on western Denge Beach
- A2 Polytrichum
Local A2 variant in excavated area near Lydd Camp
- A2 Lydd Airport
Local A2 variant near Lydd Airport
- A2 Digitalis
Local A2 variant on northern Forelands
- A2S Shingle margin variant of A2 calcifuge grassland
- A2F Maritime (cliff) Festuca rubra grassland
- A3 Slightly mesotrophic form of A2 calcifuge grassland
- B1 Mesotrophic vegetation
- B2 Wetland vegetation
- B3 Arrhenatherum elatius grassland
- B3(S) Jury's Gap
Local B3 variant at Jury's Gap
- C Strandline vegetation
- E Sambucus nigra scrub
- G Geranium robertianum vegetation
- I Ilex aquifolium scrub
- P Prunus spinosa scrub

TABLE 2. Vegetation types at Dungeness showing equivalence between local codes and N.V.C. categories.

Local code	N.V.C. equivalent(s)
A1	W23 <i>Ulex europaeus</i> , <i>Rubus fruticosus</i> underscrub community; some affinity with W23b <i>Rumex acetosella</i> sub-community.
A2	U1 <i>Festuca ovina</i> , <i>Agrostis capillaris</i> , <i>Rumex acetosella</i> calcifuge grassland community; a close fit to U1a <i>Cornicularia aculeata</i> , <i>Cladonia</i> sub-community.
A3	U1 <i>Festuca ovina</i> , <i>Agrostis capillaris</i> , <i>Rumex acetosella</i> calcifuge grassland community; some affinity with U1f <i>Hypochoeris radicata</i> sub-community.
A2S	U1 <i>Festuca ovina</i> , <i>Agrostis capillaris</i> , <i>Rumex acetosella</i> calcifuge grassland community; no obvious affinity with any sub-community.
A2F	MC8 <i>Festuca rubra</i> , <i>Armeria maritima</i> maritime cliff community; close to MC8a typical; also MC5 <i>Armeria maritima</i> , <i>Cerastium diffusum</i> therophyte communities.
B1	U1 <i>Festuca ovina</i> , <i>Agrostis capillaris</i> , <i>Rumex acetosella</i> calcifuge grassland community; in part a good fit to U1d <i>Anthoxanthum odoratum</i> , <i>Lotus corniculatus</i> sub-community.
B2	W24 <i>Rubus fruticosus</i> , <i>Holcus lanatus</i> underscrub or M23 <i>Juncus effusus</i> , <i>Galium palustre</i> mire
B2S	W1 <i>Salix cinerea</i> , <i>Galium palustre</i> woodland community
B3	MG1 <i>Arrhenatherum elatius</i> mesotrophic grassland; coastal and a few non-coastal stands fit MG1a <i>Festuca rubra</i> sub-community closely; others have no obvious affinity with any sub-community.
C	SD1 <i>Crambe maritima</i> , <i>Glaucium flavum</i> strandline community; SD3 <i>Atriplex hastata</i> , <i>Beta vulgaris</i> subsp. <i>maritima</i> strandline community.
G	no described N.V.C. category.
I	no described N.V.C. category.
E	no described N.V.C. category.
P	no described N.V.C. category.

Appendix 2 consists of a series of maps showing the general distributions of the various vegetation types at Dungeness. It should be emphasized that, as indicated in the captions to these maps, they do not show precise areas covered by the vegetation types. They should not, therefore, be equated with the estimates of present areas of vegetation types given by Fuller (1989), which were derived from the detailed (1:2,500) maps, an example of which is also included in Appendix 2.

4.1 The vegetation types

4.1.1 C - Strand-line communities

See Map 9 and Relevé lists 8 and 9.

The pioneer communities of the Dungeness shingle are recognizable as belonging to the N.V.C., SD3 Atriplex hastata, Beta vulgaris subsp. maritima and SD1 Crambe maritima, Glaucium flavum strand-line communities. At Dungeness the SD3 community comprises only Atriplex glabriuscula, which colonizes the strand-line debris on the most recently formed east coast ridge. The community is also present on the degrading ridge along the south coast.

Inland of the SD3 community, along the east coast, the next two to three ridges (the zone broadening to four or five ridges near the ness) are occupied by the SD1 community, in which Crambe maritima is dominant but very scattered, with occasional plants of Rumex crispus, Senecio viscosus, Solanum dulcamara and Atriplex glabriuscula. This community also occurs on the degrading south coast ridge. On the east coast SD1 grades quickly (within one or two ridges) into the B3

Arrhenatherum elatius grassland, described below. It is noteworthy that Glaucium flavum is absent from the SD1 community, on the prograding, east coast ridge at Dungeness, probably because of the complete stability of this shingle, and the lack of regular, freshly-deposited fine material. Glaucium flavum at Dungeness seems to be confined to disturbed shingle.

Lathyrus japonicus belongs in the SD1 sub-community, but is a very local species at Dungeness, being largely restricted to the area immediately around the ness, and there not found in any quantity.

The shingle substrate associated with these communities contains negligible fine (humic or mineral) material (range for SD3 is 0.5 to 0.9 g per kg shingle; for SD1 is 0.4 to 10 g per kg shingle) except for very small amounts immediately around the Crambe maritima plants. The pH, in so far as it can be measured with any significance from pebble washings, is near neutral (pH range for SD3 is 7.5 to 8.3; for SD1 is 5.2 to 7.6).

4.1.2 B3 - Arrhenatherum elatius grassland

See Map 7 and Relevé list 7.

Immediately inland of the strand-line communities along the east coast of Dungeness, there is present a very open vegetation type in which Arrhenatherum elatius is dominant, with only a few important associated species, namely Galium mollugo, Rumex acetosa, Senecio jacobaea, Vicia sativa, Hypochoeris radicata and Silene vulgaris subsp. maritima. The shingle substrate on which this community occurs contains a limited amount of fine material (1.5 to 22.7 g per kg shingle) and is moderately acid in reaction (pH range 5 to 5.5).

A floristically somewhat similar, but more variable community occurs at some inland sites at Dungeness, in places on the old excavated surface of the Long Pits area, and on some apparently little disturbed ridges south of the Burrowe's Pit and in the Water Board area.

In some instances this more variable community is very close in composition to the coastal form, being very open and species-poor, with Arrhenatherum elatius, Galium mollugo, Rumex acetosa and R. crispus important. It tends to occur on apparently intact ridges.

In other cases, a more species-rich Arrhenatherum community occurs, with Rubus fruticosus agg. constantly present and more-or-less co-dominant, plus elements of a A2 calcifuge grassland sub-community (see p. 24), e.g. Teesdalia nudicaulis, Dicranum scoparium, Anthoxanthum odoratum and Teucrium scorodonia; Senecio jacobaea, Rumex crispus, Ranunculus repens and Potentilla reptans may also be present. This species-rich variant is usually associated with shingle containing slightly greater amounts of fine material (0.6 to 32.6 g per kg shingle) which is moderately acid in reaction (pH range 4.1 to 5.6). However, the overriding factor responsible for the occurrence of this variant is likely to be increased moisture, given its restriction to the lowered, excavated surface of the Long Pits area. In some instances this variant approaches the B1 mesotrophic type of vegetation (see p. 28), with the shingle fine fraction tending to be very high (24.6 to 207.5 g per kg shingle), and the pH appreciably elevated (pH range 5.4 to 8.4).

Finally, a further form of this vegetation type occurs on very old ridges at Jury's Gap, close to the eroding south coast. Here Silene vulgaris subsp. maritima is the dominant species, and the ridges presumably carried, at one time, A2 calcifuge grassland.

Some stands are quite lichen-rich, suggesting some affinity with A2 calcifuge grassland (see Figure 2). As with the east coast version of this vegetation type, the fine fraction is very low (1.5 to 2.9 g per kg shingle), but the pH is slightly higher (pH range 5.5 to 6.4).

All of these Arrhenatherum elatius-dominated variants can be accommodated in the N.V.C. community MG1 Arrhenatheretum elatioris mesotrophic grassland. The coastal, species-poor variant, and perhaps the very similar inland, species-poor variant, seem to be very close to the MG1a Festuca rubra sub-community, although this grass species is not always present in the Dungeness sub-community. The more species-rich, inland variant does not equate closely with any described MG1 sub-community, perhaps being closest to the MG1c Filipendula ulmaria sub-community. Although this particular species is absent, other indicators of the damper conditions of the sub-community, Ranunculus repens and Rubus fruticosus agg., are present.

4.1.3 A1 - Cytisus scoparius scrub

See Map 1 and Relevé list 1.

In terms of humic soil generation, Cytisus scoparius is undoubtedly the single most important species at Dungeness in the shingle primary succession. On the east coast it first appears as very scattered plants in the mid-B3 Arrhenatherum elatius zone. Further inland, it is much more densely distributed and forms a mosaic with the younger ridge elements of the A2 calcifuge grassland (see p. 24). It is concentrated in a band, about 20 ridges wide, and in places is sufficiently dense to warrant recognition as a distinct vegetation type, rather than simply as a mosaic component of the A2 calcifuge grassland.

Away from Denge Beach, the only other substantial areas of primary Cytisus scoparius scrub occur on some intact ridges on the southern parts of Holmstone Beach and Forelands.

The Cytisus scoparius scrub is up to 1 m in height and, when young and vigorous, is very dense and tends to exclude most other species. In small gaps in the scrub and around the margins, species typical of the A2 calcifuge grassland occur. A few of these, e.g. Rumex acetosa and Digitalis purpurea, may be slightly favoured in these microsites. Amid the bushes, the shade and comparative damp favour the development of a species-poor bryophyte assemblage, which includes Hypnum cupressiforme, H. jutlandicum, Eurhynchium praelongum, Aulacomnium androgynum, Brachythecium rutabulum and Lophocolea heterophylla.

Elsewhere at Dungeness, in places where the shingle has been disturbed, either superficially or as a result of excavation, providing a new surface for colonization, Cytisus scoparius and more especially Ulex europaeus behave as secondary colonists, sometimes forming dense stands. Frequently, such stands occur near roads and railway tracks, but several large, remarkably isolated patches of Ulex europaeus are present on apparently intact shingle ridges to the south of the Burrowe's Pit, in an area otherwise occupied by the A2 calcifuge grassland. It is possible that these patches are sited on wartime mortar bomb target areas, where a combination of superficial but concentrated physical disturbance and associated chemical pollution destroyed the original vegetation and provided conditions suitable for colonization by Ulex europaeus. If this is the case, then it can be concluded that probably all stands of Ulex europaeus scrub on the shingle are of secondary origin.

The species associated with these secondary Cytisus scoparius and Ulex europaeus patches are similar to those found with primary colonizing Cytisus scoparius.

In terms of N.V.C. categories, these various forms of Cytisus scoparius, Ulex europaeus scrub can be accommodated in the W23 Ulex europaeus, Rubus fruticosus agg. scrub community, but the fit is not always good, especially at sub-community level. The primary colonizing Cytisus scoparius scrub, and some of the secondary Cytisus scoparius and Ulex europaeus scrub, are close to the W23b Rumex acetosella sub-community, but with Rubus fruticosus agg. notably absent. Other forms of Ulex europaeus scrub at Dungeness are more variable in terms of associated species.

The primary colonizing Cytisus scoparius scrub is associated with a free-draining shingle substrate, with a moderate level of fine (humic) material (7.2 to 43.4 g per kg shingle) and a moderately acid pH (pH range 4.1 to 6.1), somewhat intermediate between that of coastal B3 Arrhenatherum elatius grassland and A2 calcifuge grassland.

4.1.4 A2, A3, A2S and B1 - Calcifuge grasslands

See Maps 2, 3, 4 and 6 and Relevé lists 2, 3 and 5.

The major vegetation types of the mature and older ridges at Dungeness appear to belong within the N.V.C. U1 Festuca ovina, Agrostis capillaris, Rumex acetosella calcifuge grassland community. This community is described as being characteristic of base-poor, oligotrophic, summer-parched habitats in lowland Britain, associated with free-draining soils over sands and fine gravels. Dungeness, with its very well-drained shingle substrate, and with annual rainfall at <800 mm, falling

mostly in the period July to January (peaking in November) and with less than 140 wet days per annum (Barlow 1989), certainly provides a range of the necessary climatic conditions required for the development of this community. The mean annual maximum air temperature of 21.5°C given for Dungeness (Barlow 1989) actually falls below the value of 26°C for the U1 community, but at the surface shingle and humic soil surface temperatures would be greater and may often exceed 26°C. Strong winds, which are a particular feature of the Dungeness climate (Barlow 1989) would in any case greatly contribute towards generating a marked soil-water deficit, which is no doubt the key factor in the establishment of the U1 community.

Within the U1 community at Dungeness, the A2 vegetation appears to belong to the U1a Cornicularia aculeata, Cladonia arbuscula sub-community. Festuca ovina is replaced by the very closely-related species F. tenuifolia, as a constant and sometimes dominant grass, and Agrostis capillaris is occasional. Rumex acetosella, Teucrium scorodonia and Anthoxanthum odoratum are also constant species, and together with a few other species, notably Jasione montana, Teesdalia nudicaulis, Aira praecox, Sedum anglicum, Hypochoeris radicata, Hieracium pilosella, Silene vulgaris subsp. maritima and the nationally rare and very local S. nutans, they form the phanerogamic element of the vegetation. Cuscuta epithymum is frequent, parasitizing Teucrium scorodonia and Silene nutans in particular.

Lichens and mosses form another important element of this sub-community. At Dungeness, the constant species are Coelocaulon aculeatum (= Cornicularia aculeata), Cladonia ciliata (= C. tenuis) and Dicranum scoparium, whilst C. portentosa is regularly present. Any of these, except Coelocaulon aculeatum, may be locally dominant, or

co-dominant with certain phanerogams. Other Cladonia species, including C. verticillata, C. gracilis, C. furcata, C. chlorophaea agg., C. foliacea and to a lesser degree C. floerkeana, C. rangiformis, C. squamosa, C. uncialis and C. polydactyla, together with Hypogymnia physodes and the mosses Hypnum cupressiforme, Bryum capillare, Ceratodon purpureus, Polytrichum juniperinum and Campylopus introflexus, contribute to the diverse and rich cryptogamic element of this vegetation type.

The A2 vegetation occurs where disturbance of the shingle surface is absent or only very slight. The shingle substrate contains much fine (humic) material (8.6 to 78.8 g per kg shingle) of low pH (pH range 3.9 to 4.9). It occurs away from the shingle-alluvial margins and local low-lying wetland areas, and is generally well inland of the degrading south coast. It is largely confined to Denge Beach and may have been lost from much of the Lydd Ranges through past disturbance of the shingle. Today, Holmstone Beach and Jury's Gap contain only isolated fragments.

On parts of western Denge Beach, towards the Dengemarsh Road, there occurs a variant of the A2 calcifuge grassland which is undoubtedly derived directly from the typical A2 vegetation. It is, in essence, a fragmented and degraded form of the latter, in which phanerogams are much reduced in cover and diversity, often the only species present being Rumex acetosella. The cryptogamic element, on the other hand, is much more prominent and varied. The variant (A2 fragmented) has been mapped as A2 calcifuge grassland.

The origin of this variant is not clear. It is possible that, through the processes of natural succession, the shingle substrate, which has amounts of fine material similar to typical A2 calcifuge grassland

(31.4 to 54.4 g per kg shingle), but has become even more acid (pH range 3.5 to 3.8), is suitable only for extreme calcifuge species. Alternatively, mortar bomb impacts, associated with the known use of this region as a target area in the past, might have destroyed the vegetation, allowing the surface humic soil gradually to dry out and be blown away. A similar origin is suggested for some large patches of A1 secondary Ulex europaeus scrub in the same area (p. 23).

Along the margins of the shingle beaches and around the edges of natural wetlands at Dungeness, where shingle dips below deposits of alluvial soils, the A2 calcifuge grassland grades into another quite distinct variant, A2S, which seems currently not to be accommodated in N.V.C. categories. This A2S variant also occurs on some eroding ridges adjacent to the south coast. Floristically, it is very similar to A2 vegetation but with a different quantitative balance between the species involved. In particular Teesdalia nudicaulis, Sedum anglicum and Silene vulgaris subsp. maritima, and the lichens Cladonia foliacea, C. rangiformis and C. gracilis, either collectively or in part, tend to be much more prominent than in A2 calcifuge grassland.

The substrate at the shingle margins is slightly less acid (pH range 4.0 to 5.8) than in the A2 vegetation type, and the microclimate may be slightly moister owing to closer proximity to alluvial soils. It is also possible that the A2S variant is favoured where the shingle has been disturbed, e.g. in part of the Long Pits area, or where grazing is more intensive. Rabbits currently colonize shingle margins, where the mixture of humic soil and shingle is sufficiently firm for their burrowing activities. Also on parts of the Lydd Ranges, isolated patches of shingle occur within extensive areas of alluvial deposits. These are or have been heavily

grazed by sheep and often carry fragments of A2S vegetation.

Near to the south coast, the soil underlying the A2S vegetation is slightly less acid than that found under other A2S vegetation types, occurring along shingle margins, and this is attributed to the close proximity of the sea to the ridges concerned.

Where shingle ridges have been considerably disturbed, and especially where exogenous fine material has been introduced into the shingle, another distinct vegetation type, B1, is invariably present. In part, this appears to be equivalent to the N.V.C. Uld Anthoxanthum odoratum, Lotus corniculatus sub-community, but many stands are encountered which do not fit well into this category, nor any other U1 sub-community. At Dungeness this vegetation type is especially associated with road margins, tracks and paths, and the surrounds of houses and other buildings. It is also distinctive of heaps of soil and domestic waste imported from outside the Dungeness area and dumped alongside the old railway lines in the Long Pits area, and of the material heaped up over old wartime bunkers. These substrates have a moderate to very high fine (humic plus mineral) fraction (29.1 to 16,807.1 g per kg shingle) and are generally mildly acid to alkaline in reaction (pH range 5 to 8.5).

Constant species for the whole range of B1 types are Plantago lanceolata, Poa compressa, Senecio jacobaea and Festuca rubra. The vegetation varies from that associated with comparatively dry conditions along roadsides, where the total fine fraction in the shingle is fairly low and somewhat sandy in texture, to that associated with consolidated, often raised, tracks and heaps (see above) which cross the shingle in the Long Pits area. Here the fine fraction is especially high at

often more clay-like in texture, particularly in the heaps deposited alongside old railway tracks. As a consequence of the high clay content, conditions are presumably slightly moister than usual and this may favour the growth of Rubus fruticosus, often present here, but normally absent from the drier, more sandy habitats. All forms of the B1 vegetation type are very species-rich, particularly the drier and more open roadside communities.

Inevitably, intermediate forms between the various types of calcifuge grassland exist. For mapping purposes it was possible to identify an intermediate between the markedly calcifuge A2 grassland and the more mesotrophic B1 forms. In this intermediate variant, A3 (which may have some affinity with the N.V.C. Ulf Hypochoeris radicata sub-community), the presence at very low cover values of one or two species of the B1 vegetation type, e.g. Senecio jacobaea, Cerastium fontanum, Poa compressa and Plantago lanceolata, was sufficient to allow identification. The A3 variant occurs on both intact and excavated shingle surfaces (notably in the Long Pits area) and the substrate has similar amounts of fine (humic) material to the A2 vegetation type (6.6 to 185.0 g per kg shingle), but is slightly less acid (pH range 4.2 to 5.6).

Three other possible variants of the calcifuge vegetation are worthy of mention, all of which have been mapped as A2 calcifuge grassland.

Some oddly contoured, very shallow ridges, situated immediately south of Lydd Airport, carry a vegetation type which in the TWINSPAN classification is grouped with other forms of calcifuge grassland and seems to be very close, floristically, to the typical A2 calcifuge vegetation. However, in a previous survey of the area,

carried out in the summer of 1985 (Ferry & Waters 1985), these ridges carried a flora containing an abundance of annual grasses, especially Vulpia bromoides, and also other annual species, including Cerastium diffusum and Trifolium ornithopodioides. Either the vegetation has changed in the intervening period or these annual species are intolerant of the unusually dry summer conditions currently being experienced. The substrate contains more fine material than is found with typical A2 calcifuge grassland (73.5 to 211.6 g per kg shingle) with a lower pH (pH range 3.2 to 3.3).

In an area of very flat excavated shingle just to the south of Lydd Camp, the very compacted substrate is composed of pebbles set in a somewhat sandy matrix (100.6 to 147.6 g per kg shingle) of acid reaction (pH range 3.8 to 4.5). A form of calcifuge vegetation dominated by Polytrichum commune and a mixture of Cladonia species, with few vascular plant species, has developed here. Tiny fragments of this vegetation type also occur on ridges near to the Dungeness Bird Observatory where they may be associated with human disturbance. Despite its distinctive appearance, stands of this vegetation are grouped with typical A2 by the TWINSpan analysis.

Finally, along the margins of the northern part of Forelands Beach, a very open form of calcifuge vegetation dominated by Digitalis purpurea occurs. The TWINSpan classification of this vegetation type indicates some affinity with other A2 vegetation types. Associated species are few and include Aira praecox, Rumex acetosella and Festuca tenuifolia and also Holcus lanatus and Poa annua. The substrate pH (pH range 3.5 to 4) and fine fraction (21.8 to 45.0 g per kg shingle) are very comparable with those for A2 calcifuge grassland.

4.1.5 Forms of scrub vegetation

See Maps 10, 11 and 12 and Relevé lists 11, 12 and 13.

Scrub vegetation, in addition to the A1 Cytisus scoparius/Ulex europaeus-dominated type (see p. 22), occurs in a variety of situations at Dungeness. On drier shingle the important species are Ilex aquifolium, Sambucus nigra and Prunus spinosa. Sallow scrub or carr, consisting almost entirely of Salix cinerea, is dealt with under wetland habitats (p. 35). Over the whole of the Dungeness shingle, there are rare occurrences of individuals of Crataegus monogyna, Populus tremula (usually clumps amongst sallow), Betula pendula and even a very prostrate specimen of Quercus robur, by a roadside near the the ness. Pteridium aquilinum, not a woody shrub but included here for convenience, is quite rare on the Dungeness shingle, occurring at a few scattered localities in the Long Pits area, at the western margin of the Water Board area, near the southern Open Pit and in an excavated area near Lydd Camp.

Ilex aquifolium (I), is confined almost entirely to the northern section of Holmstone Beach, with only very scattered individuals occurring elsewhere on the shingle. A detailed account of the holly 'wood' is given by Peterken & Hubbard (1972), whilst Andrews (1988) provides an up-to-date picture of the current status of the 'wood', with particular reference to its decline since 1972.

The hollies on Holmstone Beach are widely spaced, with very little vegetated shingle between the clumps. It is quite clear, from evidence in the form of humic

soil buried below the shingle surface, that the holly 'wood' was once sited on vegetated shingle, presumably A2 calcifuge grassland. This grassland was probably destroyed by army activities, especially vehicle movements in the past, and nothing now remains, disrupted vegetation and humic soil having blown away.

The holly clumps vary from 3 to 15 m across; many are fairly healthy and vigourous, others are moribund but sometimes regenerating from near the ground. No seedling hollies are present. Sambucus nigra is a common associated species but never dominant. Four specimens, one quite large, of Taxus baccata occur among the hollies, as do occasional plants of Rubus fruticosus agg. and Lonicera periclymenum. Within and around the fringes of individual holly clumps a limited flora exists, including Rubus fruticosus agg., Solanum dulcamara, Corydalis claviculata (often relatively abundant) and elements of A2 calcifuge grassland, e.g. Teucrium scorodonia. Ruscus aculeatus is reported to be present.

The shingle substrate within the holly clumps contains very similar amounts of humic material (8.0 to 44.6 g per kg shingle) to that associated with A2 calcifuge grassland, of rather acid reaction (pH range 4.1 to 4.3). Conditions within the clumps are heavily shaded and relatively cool and damp. Ilex aquifolium vegetation, of the type that occurs on the Dungeness shingle, is not currently included amongst N.V.C. woodland and scrub (W) categories.

Sambucus nigra (E) usually occurs with other scrub species, e.g. Ilex aquifolium and Ulex europaeus, and with Salix cinerea in wetter areas. However, isolated, relatively pure stands do occur, e.g. along the western margin of the R.S.P.B. reserve. Under the Sambucus nigra canopy, the associated field layer is usually species-

poor and rather open with much bare humic soil. Shade favours such mosses as Brachythecium rutabulum, Eurhynchium praelongum and Hypnum cupressiforme, whilst Teucrium scorodonia is generally the dominant vascular plant. Sambucus nigra is associated with rather coarse shingle containing appreciable amounts of fine material (36.4 to 70.8 g per kg shingle) of acid reaction (pH range 3.5 to 3.8).

A notable feature of Sambucus nigra is its epiphytic lichen flora, which is appreciably richer than that of Ilex aquifolium. It includes Xanthoria parietina, Physcia species, Parmelia glabratula, P. caperata, P. sulcata, Ramalina farinacea, Lecanora confusa, Diploicia canescens and Buellia punctata.

Neither Sambucus nigra scrub, in its pure form, nor the associated epiphytic lichen flora has been described previously in N.V.C. terms, but should presumably be included amongst woodland and scrub (W) categories.

Prunus spinosa (P) scrub at Dungeness is commonly distributed along most shingle margins and around isolated natural wetlands. It has also colonized extensively on parts of the excavated, Long Pits area, and across the southern part of Holmstone Beach. The height of patches ranges from very prostrate, which is frequent, to between 0.3 to 2 m tall. In places, e.g. west of the Lade Pit, prostrate and tall Prunus spinosa occur in close proximity, so the variation is presumably partly genotypically based.

Prunus spinosa is very long-lived, and individual patches are representative of different phases in the growth cycle. Young, vigorously growing plants are densely foliated and often flower and fruit readily, but carry little by way of epiphytic lichens. Older, mature

and especially senescent and moribund plants, on the other hand, are invariably rich in epiphytic lichens and associated terricolous lichens and bryophytes, which grow on and amongst the branches. A possible exception to this rule is when Prunus spinosa plants have died rather suddenly, perhaps through a lowering of the water table in the shingle; these tend to lack lichens.

In its richest form the epiphytic lichen flora includes various species of Hypogymnia, Parmelia, Evernia, Lecanora, Graphis, Parmeliopsis, Pseudevernia and, notably, Usnea species, many of which occur at high cover levels on the branches of the blackthorn bushes. The assemblage as a whole, on Prunus spinosa, is nationally unique, and some species, e.g. Usnea rubicunda and U. glabrata, are very rare in lowland Britain. Of the associated terricolous bryophytes, the moss Antitrichia curtipendula is very rare outside of northern, upland Britain.

Terricolous lichens, e.g. Cladonia ciliata, C. rangiformis and C. furcata, lodge amongst the Prunus spinosa branches, as do certain bryophytes, including the liverworts Frullania tamarisci and Lophocolea bidentata s.l.

Prunus spinosa scrub at Dungeness is associated with rather coarse shingle substrate with rather little fine (humic) material (0 to 8.8 g per kg shingle) of moderately acid reaction (pH range 4.6 to 5.8). It is a very deep-rooted plant and one of the few on the shingle dependent on reaching down to the water table for its water supply. The current moribund state of some of Prunus spinosa patches on Denge Beach, in both the R.S.P.B. reserve and Water Board areas, may have been caused by a draw-down of the water table, through

excessive gravel extraction and water abstraction over the last 20 years.

4.1.6 B2 - Wetlands

See Map 8 and Relevé list 6.

Although true wetland communities, e.g. open water and reedswamp, are excluded from this survey, transitional forms between these and drier shingle vegetation types need to be considered because they frequently occur directly on shingle, where the water table is more-or-less at the surface. The most important examples are on the excavated shingle of the Long Pits area and on northern Holmstone Beach, near to the Lydd Camp. Elsewhere, such vegetation fringes natural wetlands and some of the artificial pits where marginal conditions are suitable, i.e. of gentle slope and not subject to erosion by wave action.

Where it is low-growing and largely herbaceous with no tree cover, the vegetation often bears some resemblance to the N.V.C. W24 Rubus fruticosus agg., Holcus lanatus woodland underscrub community, but not to any particular sub-community. Less commonly, the vegetation has some affinities with the M23 Juncus effusus, Galium palustre mire community. In other instances, a somewhat similar field layer to the W24 community, albeit rather less species-rich, occurs under more-or-less dense Salix cinerea canopy, and is best classified as W1 Salix cinerea woodland. Extensive examples of this community occur on the low-lying parts of the Long Pits excavation. Sometimes Salix cinerea, often as isolated clumps of one or two trees, is associated with slightly drier conditions on the margins of A2 calcifuge grassland. At one locality, on excavated

shingle adjacent to Lydd Camp, Salix cinerea is mixed with Betula pubescens, to form a rather discontinuous canopy, associated in parts with either W24 Rubus fruticosus agg., Holcus lanatus woodland underscrub or more rarely with M23 Juncus effusus, Galium palustre mire community.

The shingle substrate associated with the W24 woodland underscrub community contains variable amounts of fine (humic) material (6.6 to 250.2 g per kg shingle) of neutral reaction (pH range 5.7 to 8.5) and tends to remain damp in summer with regular flooding in winter.

4.1.7 A2F - Maritime (cliff) grassland

See Map 5 and Relevé list 4.

Along the eroding southern coast of Dungeness, particularly seaward of the so-called 'Green Wall', old to ancient ridges, which originally carried A2 calcifuge grassland, are being subjected to increasingly saline conditions. These derive from constant salt spray input and very occasional flooding by high spring tides, accompanied by strong, onshore, storm-force winds. As a result the vegetation is modified. It may be transformed into the A2S calcifuge grassland (see p. 27), in which Teesdalia nudicaulis, Sedum anglicum, Silene vulgaris subsp. maritima, Cladonia foliacea, C. rangiformis and C. gracilis take on particular importance.

In other instances the transformation is greater, and a form of maritime grassland, A2F, develops in which the constant species are Festuca rubra, Armeria maritima, Silene vulgaris subsp. maritima, Cladonia rangiformis and Cerastium fontanum. This vegetation equates most closely with the N.V.C. MC8 Festuca rubra, Armeria maritima maritime cliff community (MC8a, typical and MC8g, Armeria

maritima sub-communities), and in some areas with the M05 Armeria maritima, Cerastium diffusum community. Compared with both the A2 or A2S calcifuge grasslands, this A2F grassland is rather more open in character, with Festuca rubra usually a clear dominant.

The conditions required for the development of these two rather different south coast vegetation types are not entirely clear. The least modified floristically is the A2S calcifuge grassland, which grows on a shingle substrate differing in appearance only slightly from that characteristic of A2 vegetation. Such A2S vegetation may be associated with either more elevated ridges, less subject to flooding by the sea, or ridges which previously carried intact A2 calcifuge grassland. The A2F grassland, on the other hand, is very distinct, the associated shingle substrate containing very variable amounts of fine material (8.7 to 279.4 g per kg shingle) which is neutral-to-alkaline in reaction (pH range 6.4 to 8.4). For the most part, A2F maritime grassland appears to favour the less elevated, more readily flooded ridges further west along the south coast, where it is in large-scale mosaic with salt marsh vegetation and saline lagoons. In this region of the south coast, towards Jury's Gap, the ridges are, of course, more ancient and may previously have carried a fragmented A2 calcifuge grassland.

4.1.8 G - Geranium community

See Map 5 and Relevé list 10.

Finally, and still in this south coast region, 'lows' of coarser shingle between the variously vegetated 'fulls', often become colonized. Virtually everywhere else at Dungeness the 'lows' (other than those where the surface is sufficiently near the water table to permit

the establishment of wetland) remain free of vegetation for reasons explained by Fuller (1987). On the south coast the colonizer is, almost exclusively, scattered Geranium robertianum subsp. maritimum, with just a very few equally scattered plants of Festuca rubra, Silene vulgaris subsp. maritima, Anthoxanthum odoratum, Vicia sativa, Cerastium fontanum and Hypnum cupressiforme. A much more fragmented form of this vegetation sometimes occurs on the east coast of Dungeness, in lows within the B3 Arrhenatherum elatius grassland zone.

In such areas, fine material is virtually absent from the shingle substrate (0 to 5.2 g per kg shingle), whilst the pH of pebble washings is neutral (pH range 6.6 to 7.2). There appears to be no clear N.V.C. category for this community, but floristically it bears some resemblance to a vegetation type which colonizes some Derbyshire limestone screes (Rodwell, personal communication).

4.2 Succession

Dungeness as a whole is a complex of ecosystems, not all of which are directly on shingle, in which both the natural processes of primary succession and those associated with man's various modifications of the environment operate. The primary succession has only been studied in detail on Denge Beach. Here the sequence is believed to be as shown in Figure 4.

Whether it is possible to link this succession on Denge Beach with developments on older shingle beaches at Dungeness, where the vegetation developed much earlier and probably under rather different climatic conditions, is debatable.

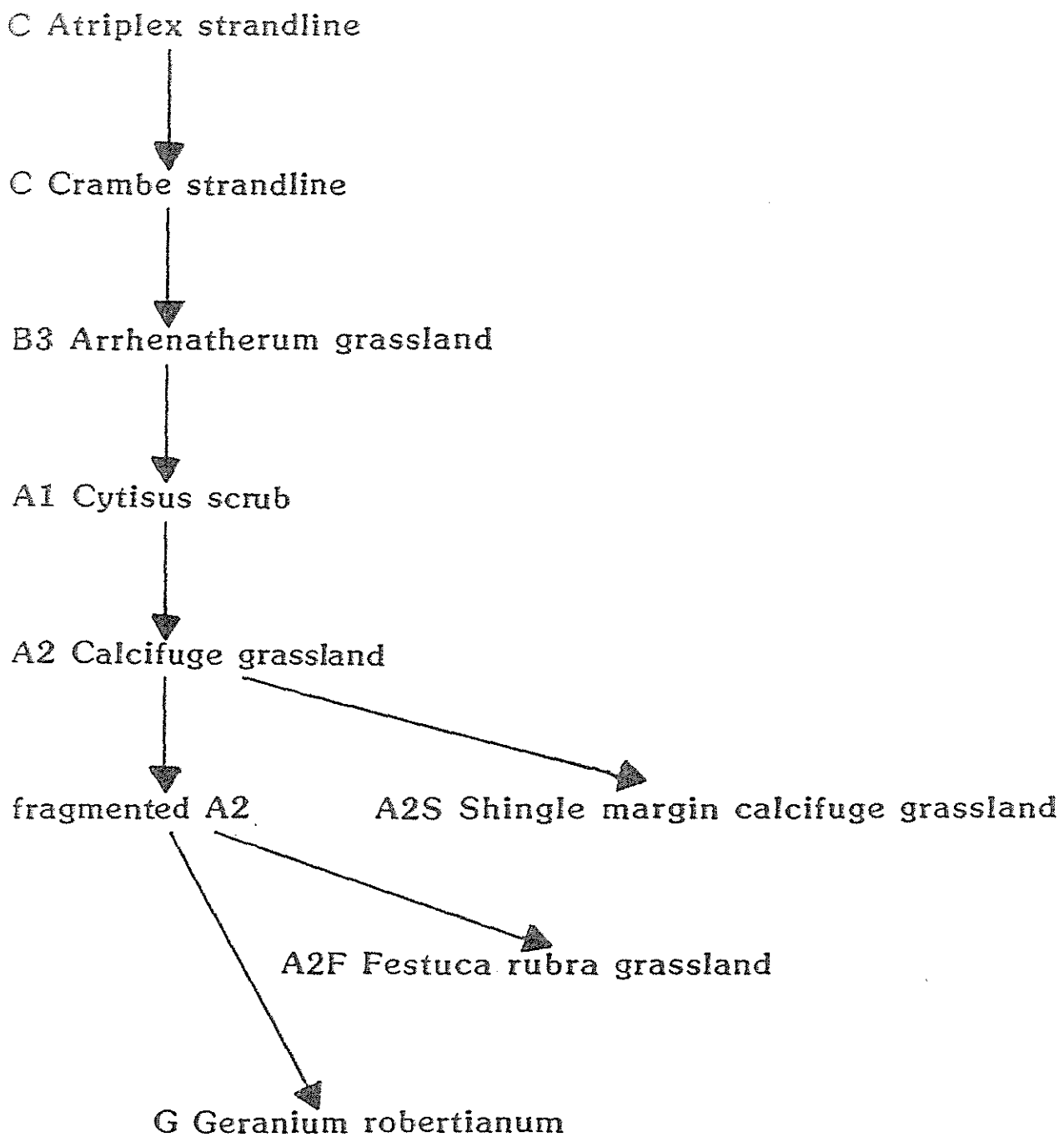


FIGURE 4. Proposed outline of the primary succession on the shingle of Denge Beach.

It has been surmised that Ilex aquifolium might be a form of woodland climax on Holmstone Beach. Ilex aquifolium is very rare on Denge Beach, and the few plants in existence are situated mainly along shingle margins and, in some cases at least, were almost certainly planted as 'sign posts' on the open shingle, e.g. the 'Half-way Bush'. Uncertainty remains about the origin, natural or man-made, of the 'wood' on Holmstone Beach. So, although Smith (1984) did report finding two small seedlings of holly on Denge Beach during her survey, it is clear that, either the conditions have not been generally appropriate for natural colonization by Ilex aquifolium, or that it would need to be planted by man.

Cyclical changes in vegetation are recognized as being integral components of successional phenomena. At Dungeness, the 'broom cycle' (Scott 1965) is acknowledged as being of key importance in bringing about the transformation from the rather open form of B3 Arrhenatherum elatius grassland to the closed A2 calcifuge grassland. The processes of humic soil generation is greatly accelerated at the A1 Cytisus scoparius scrub stage.

A parallel primary hydrosere operates in the natural wetlands, associated with the Dungeness shingle. The details of these wetland communities, particularly of the Open Pits, are discussed elsewhere (Waters 1985; Ferry & Waters 1988; Waters & Ferry 1989) and will not be elaborated on here, other than to note that the boundary between wetland and drier shingle habitats is not always sharp.

Where the shingle surface has been disturbed or, as has often been the case, excavated to a lower level but

still above water table, the natural succession has been modified or replaced by a secondary succession.

Surface disturbance of shingle, if minimal, tends to result in slight eutrophication of the habitat (reflected by a slight pH rise), which is more significant in naturally acid situations. Hence, the A2 calcifuge grassland vegetation can be readily modified to produce the slightly more mesotrophic A3 form. If the disturbance is more appreciable then the mesotrophic B1 form of calcifuge grassland appears. An input of exogenous fine material is often, perhaps invariably, associated with surface shingle disturbance, and may of its own accord lead to eutrophication.

The pattern of recolonization of excavated shingle surfaces is complex. In the Long Pits area the excavation was confined very largely to within the A1 Cytisus scoparius scrub and A2 calcifuge grassland. Recolonization has, to a degree, followed the bands occupied by previous vegetation, reflecting the lines of the old ridges. Where the excavation was relatively shallow towards the northern part of the area, some secondary vegetation is indistinguishable from A2 calcifuge grassland of the undisturbed shingle. In other instances the slightly mesotrophic A3 vegetation type has colonized. Towards the southern, deeper end of the excavation, various wetland communities, including much B2 Salix cinerea scrub, have tended to orientate along the lines of old railway tracks. In yet other places B3 Arrhenatherum elatius grassland has colonized.

5 APPRAISAL

Shingle apposition beaches are an uncommon feature of the British coastline. Of the few that exist, none

matches Dungeness in scale and complexity of structure and number of ridges. The younger ridges at Dungeness, with their associated pioneer communities, are replicated elsewhere, e.g. at Orfordness, but the mature and older ridge communities at Dungeness appear to be a unique feature amongst shingle systems in Britain.

Elsewhere in Britain, the nearest counterpart to the A2 calcifuge grassland vegetation type is to be found in the Brecklands. However, much of the equivalent grassland community in that region, classified as N.V.C. sub-community U1a, has been destroyed by overgrowth following a decline in grazing by domestic stock and rabbits and the planting and self-seeding of conifers. Grazing and the associated trampling, therefore, appears essential to the perpetuation of this vegetation type.

Grazing on the Dungeness shingle by domestic stock was once commonplace, but ceased altogether by 1963 and was in considerable decline long before that time. It is not possible today to assess the effect of past grazing regimes on any of the Dungeness shingle vegetation types, nor to judge what form the vegetation took, say in the nineteenth century, when grazing by stock was perhaps more intensive. In more recent times the rabbit populations at Dungeness declined massively, following the outbreak of myxomatosis in the 1950s, but populations have since recovered again to quite high densities in places. Unfortunately, there is no clear record of the impact of these changes in rabbit population size on the vegetation. However, the present, somewhat mesotrophic, state of the vegetation of some of the smaller areas of shingle, lying within alluvial areas which are still regularly grazed by sheep and cattle, suggests that a somewhat more mesotrophic variant of calcifuge grassland may have been more widespread in the past, when grazing was more intensive.

It is possible that a more-or-less stable calcifuge grassland vegetation has persisted for decades, if not longer, on the mature and older ridges of the Dungeness shingle. The precise form of this vegetation would depend on grazing pressures at any particular time, becoming slightly more mesotrophic (A3 and A2S) at times of high grazing intensity and more calcifuge (A2) at other times due to the very ready leaching of the shingle substrate. Unlike the situation in the Brecklands, however, grazing would appear not to be essential to the perpetuation of A2 calcifuge grassland at Dungeness, judging from the present day scene.

Of the calcifuge grassland variants, the A2S variant is possibly unique to the Dungeness scene. There are no N.V.C. records of it occurring elsewhere in Britain. Likewise, the Ilex aquifolium woodland of Holmstone Beach, and the numerous, often prostrate, patches of Prunus spinosa are a special feature of the area, apparently not found elsewhere in Britain on shingle. The epiphytic lichen communities, associated with the Prunus spinosa, have long been recognized by lichenologists as a very important assemblage in lowland Britain.

Areas of disturbed shingle, in one form or another, are now a common feature at Dungeness, resulting from the loss of much original natural vegetation. Fuller (1989) gives the present areas covered by the different vegetation types, both natural and unnatural. Losses of original shingle landscape have not been equally spread amongst the communities and sub-communities of the primary succession, nor across the different shingle beaches. What follows is an attempt to estimate losses of different natural vegetation types at Dungeness. Since it is particularly difficult to estimate losses on

the older shingle beaches of the Lydd Ranges, because of uncertainty about what the original vegetation types were, estimates for these areas should be treated with caution.

Losses of strand-line vegetation over Dungeness as a whole have been comparatively small, perhaps 5%, mostly from activities associated with the local fishermen and with the beach-feeding scheme near the ness. These losses do not seem likely to increase, though there have been reports, from time to time, of illegal harvesting of Crambe maritima from Dungeness (Peter Makepeace, personal communication).

Much B3 Arrhenatherum elatius grassland on Denge Beach has been destroyed by coastal strip development for roads, houses and the miniature railway. Moreover, housing continues to encroach upon these areas. Often, the new developments are quite small and fill odd gaps amongst existing developments, but some are on a larger scale. Collectively they contribute to a very significant erosion of the habitat. Part of the Hall's current gravel excavation near to the east coast is in the B3 zone of vegetation, particularly to the north of Lade Pit. Because this excavation runs parallel to the coast for about 2 km, a series of ridges of a particular age and stage of development have been very extensively destroyed, and are now represented only by small fragments to the south of the Kerton Road.

Total losses of natural, primary B3 grassland on Denge Beach, to date, are approximately 55%, a substantial fraction of this being recent and related to the current east coast excavation. Gains of some secondary B3 vegetation in the Long Pits area hardly offset these losses. Elsewhere, in the Lydd Ranges, patches of B3 vegetation near to the south coast may be,

in some instances, natural in origin, developed in response to increasing maritime influences. However, because of uncertainty about their origin, no estimate of losses is attempted.

Approximately 70% of the original primary A1 Cytisus scoparius scrub has been lost from Denge Beach. The Long Pits excavation in the past and Hall's current east coast excavation have been major causes of this loss, whilst the construction of the nuclear power stations in the 1960s removed what has been described as the finest area of Cytisus scoparius ridges. Most secondary A1 scrub is dominated by Ulex europaeus rather than by Cytisus scoparius, so in no sense is this an adequate replacement.

Losses in the Lydd Ranges are difficult to assess, because it might be expected that these shingle areas would have become naturally devoid of A1 scrub because of their great age. However, substantial areas of apparently natural A1 Cytisus scoparius scrub still occur on south Holmstone Beach and to a lesser extent on south Forelands, but none are to be found on the younger West Ripe Beach. Losses in the Lydd Ranges as a whole could, therefore, be as high as 50%.

The loss of A2 calcifuge grassland from Denge Beach, which amounts to about 45%, is very largely due to the extensive gravel excavations of the Burrowe's Pit, the New ARC Pit, the New Diggings and the current diggings to the west of the Burrowe's Pit. Much of what remains, however, is superficially damaged by vehicle tracks, some of fairly ancient origin, though many have appeared in recent years. Such tracks, once formed, leave an indelible mark on the landscape, and degrade the quality of the habitat.

Other natural communities related to A2 calcifuge grassland, i.e. the A2S and A2F variants, appear to have suffered minimal losses. Those that have occurred on Denge Beach are associated with the gravel excavations of Lade Pit and the New ARC Pit.

Losses of all forms of natural, calcifuge grassland from the Lydd Ranges have certainly been substantial, perhaps totalling 60%, but these are very difficult to categorize specifically. The greatest loss appears to have been of A2 and A2S, but the original natural balance of these two vegetation types is uncertain. All shingle beaches within the Lydd Ranges have suffered loss, including the area of Holmstone Beach occupied by the holly wood, where calcifuge grassland would once have been present on ridges between the holly clumps.

Prunus spinosa scrub still survives along most of the shingle margin of Denge Beach and losses appear to have been slight, perhaps about 10%. However, some patches of this vegetation occurring within large blocks of shingle, notably around the Open Pit margins, seem to have died prematurely, probably due to water stress brought about by a fall in the water table level. This resulted in the loss of some important examples of epiphytic lichen communities, and in some cases death of scrub occurred before lichen colonization could take place.

Within the Lydd Ranges, extensive areas of Prunus spinosa scrub remain around the shingle margins; here losses seem to have been small and are estimated at less than 10%.

The decrease in Ilex aquifolium on Holmstone Beach has been documented recently (Susyn Andrews, personal communication). Losses are estimated at 50% of the trees

which were present in 1939, but total losses since the first occupation by the army in the last century would certainly be greater, and would include trees which have disappeared from the neighbouring Forelands Beach.

Of the natural wetlands associated with the Dungeness shingle, none has been destroyed but some, notably the Open Pits, have suffered partial drying-out as a result of past drops in water table level, which have modified the vegetation (Ferry & Waters 1988).

Excavation down to mean water table level and the generation of water-filled gravel pits have added substantially to the total wetland area at Dungeness. Only in a few instances, however, have community and species diversities been enhanced by such activities (Henderson 1986); otherwise such gains have been made at the cost of losing natural shingle landscape and associated natural plant communities.

The range of mesotrophic (B1) forms of vegetation is, of course, an unnatural addition to the diversity of vegetation types at Dungeness, and would have increased steadily in amount with the increasing human presence at Dungeness. Undoubtedly the single most important area is the excavation associated with the Long Pits. This area has been thoroughly documented (Tim Inskip, personal communication) and over 530 species have been recorded there, many of which are distinctive of the mesotrophic (B1) types of vegetation.

A summary of present areas and estimated losses (and gains) of the various vegetation types is provided in Table 3. It should be noted that the estimates of present areas, taken from Fuller (1989), are strictly of vegetated shingle surface only and exclude, for example, non-vegetated lows associated with A2 calcifuge

TABLE 3. Vegetation types (local codes) - present areas (Fuller 1989) and estimated losses (areas are vegetated shingle only and exclude associated bare shingle). Losses given in parentheses are gross approximations.

Local codes	Present area (hectares)	Percentage estimated losses		
		Denge Beach	Lydd Ranges	Total
A1	63.8	70	(50)	(60)
A2	220.9	45	(60)	(50)
A2S	72.8	minimal		
A2F	29.7	-	minimal	0
A3	33.0	----- all gained -----		
B1	54.5	----- all gained -----		
B2	34.1	---- minimal; much gained ----		
B3	88.4	55	?	(50)
C	19.5	5	5	5
G	not estimated	-	minimal	0
I	3.0	-	50	50
E	ne	---- minimal; some gained? ---		
P	11.4	10	<10	10

grassland. Any attempt to assess the current status of a vegetation type should obviously take account of what remains and what proportion has been lost. However, it is equally important to consider the 'quality' of the elements concerned, especially of the patches that remain.

In assessing 'quality' several points need to be born in mind. Does the vegetation type form one or more large tracts or is it represented by small, widely separated patches (noting that some vegetation types, e.g. Prunus spinosa are naturally fragmented)? Small, isolated fragments of vegetation are likely to provide a less favourable habitat for invertebrate populations. Is the remaining vegetation, or part of it, adjacent to other intact seral stages of the primary succession, thus providing a valuable transect sequence? Is the vegetation, either wholly or in part, damaged? Clearly, ownership, access for the general public and activities which affect the water table will be important considerations here. In the case of secondary vegetation, does it make good any losses of natural vegetation, and does it increase diversity of habitats/species? These are but a few examples of factors which might contribute to the 'quality' of vegetation. It is to be hoped that when further plots of shingle landscape come up for consideration for development, 'quality' factors will be given high priority in making the case for conservation.

Finally, because the Dungeness shingle system is unique in Europe, and probably globally, and because sufficient still remains to provide a picture of all facets of its ecology, then decisions about the future of any of its parts should be made in the context of Dungeness alone and ~~without reference~~ to other shingle systems.

6 CONCLUSIONS

6.1 The survey revealed that some 18 distinguishable vegetation types are present on shingle at Dungeness, most of which have been resolved to the limits for mapping purposes. Two vegetation types, B1 mesotrophic vegetation (generally a product of shingle disturbance) and B2 wetland vegetation (either associated with alluvial deposits on undisturbed shingle or the result of excavation) could no doubt be further subdivided into finer categories.

6.2 Several of the vegetation types are believed to be unique to the Dungeness shingle system. The most notable of these are the A1 Cytisus scoparius scrub, the A2 calcifuge grassland variants, the P Prunus spinosa scrub and the I Ilex aquifolium scrub, all of which are confined to the older shingle ridges. However, all 18 vegetation types appear to include some species which are rare, at least in south-east England, if not nationally.

6.3 The areas of shingle occupied by most of these vegetation types are now known. Measurements confirm that many of the non-unique vegetation categories at Dungeness greatly exceed in area anything found elsewhere on shingle in the UK.

6.4 Some natural vegetation types have suffered considerable losses of area, e.g. A1 Cytisus scoparius scrub (60%), A2 plus A2S calcifuge grasslands (50%), B3 Arrhenatherum elatius grassland (50%) and I Ilex aquifolium scrub (50%), due to various forms of disturbance of the shingle. Often the disturbance has been gross, e.g. when caused by building operations or excavation; then the vegetation is entirely destroyed or

greatly altered. However, the disturbance may be less obvious, e.g. lowering the water table in the shingle; this is believed to have caused the death of some Prunus spinosa scrub in the past.

6.5 Secondary vegetation types, e.g. B1 mesotrophic vegetation and the artificially-generated bodies of B2 wetland, now occupy considerable areas of shingle. Although adding much to the diversity of vegetation and species, they should be viewed as being less important than primary (natural) vegetation types.

6.6 One particular form of secondary vegetation, A1 Ulex europaeus scrub, is associated with either gross or superficial disturbance and appears to be absent from intact shingle.

6.7 The vegetation survey of the Dungeness shingle forms part of the national (G.B.) survey being carried out for the N.C.C. by Dr Roland Randall and Miss Pippa Sneddon. An important objective of the national survey is to identify important shingle sites, in terms of vegetation cover, so that conservation and management policies for these can be effectively developed. Even at this early stage of the national survey, it has become clear that Dungeness is the key site in terms of range of vegetation types present and areas of shingle occupied.

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 Maritime cliff communities (1982) (MC)
 Mesotrophic grasslands (1982) (MG)
 Woodlands and scrub, Vols. 1 and 3 (1986) (W)
 Mires, Vol. 3 (1987) (M)
 Calcifugous grasslands and miscellaneous upland communities, Vol. 1 (1989) (U)
 Sand-dune, strandline and shingle vegetation (1989) (SD)
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APPENDIX 1

RELEVÉ LISTS 1 TO 13

Relevé lists were drawn up from TWINTAB output of the Dungeness data (see p. 12), and these are compared with the nearest equivalent National Vegetation Classification (N.V.C.) communities or sub-communities, where such exist. In some instances, two or more lists are given for a Dungeness vegetation type, indicating that it is rather variable in composition. In other instances more than one N.V.C. category may accompany the Dungeness data, indicating uncertainty about the affinity of the Dungeness data. It should be noted that the N.V.C. categories are intended to be broad-based, i.e. to be genuinely national. Hence, the required fit between the Dungeness and N.V.C. lists should not be set too high, and the emphasis should be placed on the presence of the various indicator species listed in Table 1. Nomenclature follows that used in the unpublished N.V.C. chapters.

LIST 1. A1 Cytisus scoparius-Ulex europaeus scrub compared with KVC/W23b: Ulex europaeus-Rubus fruticosus agg. scrub, Rumex acetosella sub-community.

- 1 KVC/W23b: Ulex europaeus-Rubus fruticosus agg. scrub, Rumex acetosella sub-community
2 Dungeness A1

	1	2
Ulex europaeus	V (2-9)	I (2)
Rubus fruticosus agg.	IV (1-6)	II (3)
Cytisus scoparius	II (1-6)	III (6-9)
Rubus idaeus	I (2-3)	
Agrostis capillaris	V (2-8)	
Holcus lanatus	IV (1-3)	
Galium saxatile	III (1-3)	
Rhytidadelphus squarrosus	III (1-5)	
Holcus mollis	III (1-6)	
Eurhynchium praelongum	II (1-4)	V (1-5)
Cerastium fontanum	II (1-2)	
Viola riviniana	II (3)	
Pseudoscleropodium purum	II (1-4)	
Anthoxanthum odoratum	II (1-5)	V (3-5)
Potentilla erecta	I (2-4)	
Poa pratensis	I (2-4)	
Deschampsia flexuosa	I (4)	
Calluna vulgaris	I (1)	
Rumex acetosella	I (1-3)	II (2-3)
Hypochoeris radicata	IV (1-3)	III (1-3)
Senecio jacobaea	III (1-2)	III (1)
Plantago lanceolata	III (1-3)	
Crepis capillaris	II (1-2)	
Jasione montana	II (1-2)	
Aira praecox	I (1)	
Teucrium scorodonia	I (3-5)	V (4-7)
Pteridium aquilinum	III (1-7)	
Festuca rubra	II (2-4)	
Dactylis glomerata	II (1-3)	
Rumex acetosa	I (1)	V (3-5)
Achillea millefolium	I (1)	
Silene dioica	I (1-2)	
Digitalis purpurea	I (1)	
Campanula rotundifolia	I (1)	
Rhytidadelphus triquetrus	I (1)	
Veronica officinalis	I (1-2)	
Veronica chamaedrys	I (3)	
Arrhenatherum elatius	I (1-2)	
Brachythecium rutabulum		IV (1-7)
Hypnum cupressiforme var. cupressiforme		III (1-4)
Holcus lanatus		II (4)
Dryopteris dilatata		II (1-3)
Corydalis claviculata		II (3-5)
Aulacomnium androgynum		II (1)
Cladonia foliacea		II (1)
Dicranum scoparium		II (3)
Festuca tenuifolia		II (2-3)
Aira praecox		II (1-6)
Sedum anglicum		II (1)
Poa compressa		I (1)
Hieracium pilosella		I (1)
Stellaria media		I (1-2)
Epilobium angustifolium		I (1)
Silene vulgaris subsp. maritima		I (2)

	1	2
<i>Cladonia chlorophaea</i> agg.		I (1)
<i>Digitalis purpurea</i>		I (4)
<i>Cuscuta epithymum</i>		I (1)
<i>Cladonia ciliata</i>		I (1)
<i>Teesdalia nudicaulis</i>		I (1)
<i>Cladonia macilenta</i>		I (1)
<i>Poa nemoralis</i>		I (3)
No. of samples	9	7
No. of species/sample	23(17-30)	12(8-15)

LIST 2. A2, A3 and A2S forms of calcifuge grassland compared with NVC/U1a: *Festuca ovina*-*Agrostis capillaris*-*Rumex acetosella* calcifuge grassland, *Cornicularia aculeata*-*Cladonia arbuscula* sub-community, and with NVC/U1f: *Festuca ovina*-*Agrostis capillaris*-*Rumex acetosella* calcifuge grassland, *Hypochoeris radicata* sub-community.

- 1 NVC/U1a: *Festuca ovina*-*Agrostis capillaris*-*Rumex acetosella* calcifuge grassland, *Cornicularia aculeata*-*Cladonia arbuscula* sub-community
- 2 NVC/U1f: *Festuca ovina*-*Agrostis capillaris*-*Rumex acetosella* calcifuge grassland, *Hypochoeris radicata* sub-community
- 3 Dungeness A2
- 4 Dungeness A3
- 5 Dungeness A2S (i)
- 6 Dungeness A2S (ii)

	1	2	3	4	5	6
<i>Festuca ovina</i>	V (3-9)	II (1-2)	I (1)	I (1)		
<i>Agrostis capillaris</i>	II (2-3)	V (1-9)	I (1-4)	I (1-4)		I (3)
<i>Rumex acetosella</i>	I (1-4)	III (1-5)	V (1-7)	IV (1-4)	III (3-4)	III (2-3)
<i>Dicranum scoparium</i>	IV (3-8)	I (1-2)	V (3-9)	V (1-8)	IV (1-3)	II (3-4)
<i>Coelocaulon aculeata</i>	IV (3-8)		V (1-3)	III (1-3)	IV (1-3)	I (3)
<i>Cladonia arbuscula</i>	IV (2-6)					
<i>Polytrichum piliferum</i>	III (2-7)	II (1-3)				
<i>Cladonia ciliata</i>	III (2-6)		V (1-8)	III (1-4)	V (1-7)	III (3-7)
<i>Cladonia portentosa</i>	III (2-7)		IV (1-5)	II (1-3)	V (1-8)	I (5)
<i>Cladonia foliacea</i>	III (2-3)		III (1-2)	III (1-8)	V (1-4)	V (1-3)
<i>Cladonia uncialis</i>	III (2-5)		I (1-3)	I (1)	I (1)	
<i>Cladonia furcata</i>	II (2-3)		II (1-2)	III (1-3)	II (1-2)	II (2-3)
<i>Cladonia squamosa</i>	II (2-3)	I (1-4)	I (1)	I (1)	II (2-3)	
<i>Cladonia gracilis</i>	II (2-3)		II (1-3)	I (1)	V (3)	V (2-3)
<i>Ptilidium ciliare</i>	II (2-6)					
<i>Pohlia nutans</i>	II (1-4)					
<i>Cladonia fimbriata</i>	II (3-4)					
<i>Cladonia pyxidata</i>	II (3-4)					
<i>Campylopus introflexus</i>	I (3-8)		I (1-2)	I (2)		II (2-3)
<i>Brachythecium albicans</i>	I (4-5)					
<i>Holcus lanatus</i>	I (3-4)	II (1-4)	I (1)	I (1-2)		I (2)
<i>Galium saxatile</i>	I (2)					
<i>Hieracium pilosella</i>	I (3)	I (1)	II (1-4)	II (2-5)		III (2-3)
<i>Senecio jacobaea</i>	I (2)				II (1)	I (1)
<i>Koeleria macrantha</i>	II (3-4)	I (1-3)				
<i>Hypnum cupressiforme</i> s.l.	II (2-8)	II (1-4)	I (1-2)	II (1)	II (1)	II (1-3)
<i>Calluna vulgaris</i>	I (2)	I (1)				
<i>Ceratodon purpureus</i>	I (1-2)	II (1-4)	I (2)	I (1-2)		II (2)
<i>Polytrichum juniperinum</i>	II (3-4)	II (1-9)	II (1-4)	II (2-5)	I (1)	I (2)
<i>Pseudoscleropodium purum</i>	I (5)					
<i>Pteridium aquilinum</i>	I (2-3)	I (1)				
<i>Rhytidadelphus squarrosus</i>	I (2)	I (1-3)				
<i>Epilobium angustifolium</i>	I (2)					
<i>Pleurozium schreberi</i>	I (2)					
<i>Aira praecox</i>		III (1-8)	IV (1-2)	III (1-2)		II (2-3)
<i>Cerastium fontanum</i>		I (1-3)	I (1)	IV (1-3)		I (1)
<i>Teesdalia nudicaulis</i>		II (1-2)	II (1-3)	IV (1-4)	V (2-4)	IV (2-4)
<i>Aphanes arvensis</i>		I (1)				
<i>Myosotis ramosissima</i>		I (3)				
<i>Trifolium dubium</i>		I (1-4)				
<i>Arenaria serpyllifolia</i>		I (1-3)				
<i>Anthoxanthum odoratum</i>		I (1-6)	V (1-4)	IV (1-6)	VI (3-4)	V (1-3)
<i>Lotus corniculatus</i>		I (1)		II (1-5)		
<i>Plantago lanceolata</i>		III (1-4)				
<i>Ulex europaeus</i> seedlings		I (1-3)		I (8)		
<i>Hypochoeris radicata</i>		IV (1-4)	II (1-3)	II (1)		III (1-3)
<i>Centaurea erythraea</i>		II (1-4)				
<i>Leontodon taraxacoides</i>		II (1-4)				
<i>Festuca rubra</i>		II (1-4)		I (1)		III (2-8)
<i>Umbilicaris rupestris</i>		II (1-4)				
<i>Sedum anglicum</i>		II (1-3)	III (1-2)	V (1-4)	IV (2-3)	V (2-5)
<i>Lychnis viscaria</i>		I (1-2)				
<i>Veronica spicata</i>		I (1-2)				
<i>Hieracium peleteranum</i>		I (1-4)				

	1	2	3	4	5	6
<i>Taraxacum officinale</i> agg.		I (1)				
<i>Poa annua</i>		II (1-4)				
<i>Plantago coronopus</i>		II (1-8)				
<i>Peltigera canina</i>		I (1)				
<i>Agrostis stolonifera</i>		I (1-3)				
<i>Anthyllis vulneraria</i>		I (1-2)				
<i>Trifolium repens</i>		I (1)				
<i>Ornithopus perpusillus</i>		I (1-3)				
<i>Sagina procumbens</i>		I (1-4)		II (1-3)		
<i>Bromus hordeaceus</i> subsp. <i>hordeaceus</i>		I (1-3)				
<i>Bromus sterilis</i>		I (1-3)				
<i>Oxycoccus epithymum</i>			III (1-2)	III (1-6)		I (3)
<i>Cladonia verticillata</i>			II (1-4)	II (1-4)		
<i>Jasione montana</i>		II (1-3)				IV (1-4)
<i>Cladonia flickeana</i>			I (1)		IV (1-3)	
<i>Cytisus scoparius</i> (ground)			I (4-6)			I (2)
<i>Cytisus scoparius</i> (shrub)				I (7-8)		
<i>Cladonia chlorophaea</i> agg.			III (1-3)	III (1-3)	V (3)	IV (1-3)
<i>Hypogymnia physodes</i>			I (1)	I (1-3)	II (3)	
<i>Festuca tenuifolia</i>			V (1-8)	V (1-7)	III (1-4)	II (2-5)
<i>Silene nutans</i>			III (2-4)	III (1-6)	III (1-2)	
<i>Teucrium scorodonia</i>			V 91-8)	V (2-7)	V (3-4)	V (3-6)
<i>Cladonia rangiformis</i>			I (1-2)	III (1-4)	IV (2-5)	V (3-5)
<i>Rumex acetosa</i>			III (1-3)	V (1-5)	III (1-3)	III (1-2)
<i>Silene vulgaris</i> subsp. <i>maritima</i>			II (2-5)	I (1)	IV (3-5)	V (1-5)
<i>Bryum capillare</i>			II (1)	I (1)	I (2)	III (1-2)
<i>Poa compressa</i>			I (1)	III (1-2)		II (2-3)
<i>Vicia hirsuta</i>			I (1)	I (1)		
<i>Peltigera polydactyla</i>			I (1)			
<i>Cladonia polydactyla</i>			I (1)			
<i>Digitalis purpurea</i>				I (4)	III (4-5)	II (1-3)
<i>Camptopogon paradoxus</i>				I (1-3)	IV (3-4)	
<i>Eurhynchium praelongum</i>				I (1)		
<i>Ranunculus repens</i>				I (2)		
<i>Urtica dioica</i>				I (1)		
<i>Rubus fruticosus</i> agg.				I (1-4)		
<i>Sonchus arvensis</i>				I (1)		
<i>Potentilla reptans</i>				I (1)		
<i>Cerastium diffusum</i> subsp. <i>diffusum</i>				I (1)		
<i>Dipsacus fullonum</i>				I (1)		
<i>Plantago lanceolata</i>				I (1)		
<i>Vicia sativa</i>				II (1)		
<i>Arrhenatherum elatius</i>				I (2-5)		
<i>Rumex crispus</i>				I (1)		
<i>Galium mollugo</i>				II (2)		
<i>Galium aparine</i>				I (2)		
<i>Plantago media</i>				I (2)		
<i>Dicranoweisia cirrata</i>				I (1)		
<i>Grimmia pulvinata</i>				I (1)		
<i>Parmelia saxatilis</i>				I (1)		
<i>Vulpia bromoides</i>				I (1-2)		
<i>Evernia prunastri</i>					I (1)	
<i>Leontodon autumnalis</i>						I (3)
<i>Barbula cylindrica</i>						I (2)
<i>Sonchus asper</i>						I (1)
<i>Armeria maritima</i>						II (1-3)
<i>Cirsium vulgare</i>						I (1)
<i>Sedum acre</i>						I (1)
<i>Atriplex glabriuscula</i>						II (3)
<i>Cladonia cervicornis</i>					I (1)	I (1)
<i>Parmelia sulcata</i>					I (1)	
<i>Atriplex patula</i>						I (1)
<i>Carlina vulgaris</i>						I (1)

	1	2	3	4	5	6
<i>Campylopus pyriformis</i>					I (1)	
<i>Hypogymnia tubulosa</i>					I (1)	
<i>Parmelia caperata</i>					I (1)	
<i>Beta vulgaris</i> subsp. <i>maritima</i>						I (1)
No of samples	18	16	19	17	6	8
No of species/sample	14(7-20)	15(7-27)	15(9-20)	18(11-25)	17(12-24)	18(13-21)

LIST 3. Further forms of A2 calcifuge grassland (fragmented, Polytrichum, Lydd Airport and Digitalis) compared with NVC/U1a: Festuca ovina-Agrostis capillaris-Rumex acetosella calcifuge grassland, Cornicularia aculeata-Cladonia arbuscula sub-community.

- 1 NVC/U1a: Festuca ovina-Agrostis capillaris-Rumex acetosella calcifuge grassland, Cornicularia aculeata-Cladonia arbuscula sub-community
 2 Dungeness A2 (fragmented)
 3 Dungeness A2 (Polytrichum)
 4 Dungeness A2 (Lydd Airport)
 5 Dungeness A2 (Digitalis)

	1	2	3	4	5
Festuca ovina	V (3-9)				
Agrostis capillaris	II (2-3)		I (1)	V (3-6)	II (2)
Rumex acetosella	I (1-4)	IV (4-5)	I (1)	V (4-5)	IV (1-3)
Dicranum scoparium	IV (3-8)			V (3-5)	
Coelocaulon aculeata	IV (3-8)	V (2-3)			
Cladonia arbuscula	IV (2-6)				
Polytrichum piliferum	III (2-7)				
Cladonia ciliata	III (2-6)	IV (1-2)	IV (1-2)	I (1)	
Cladonia portentosa	III (2-7)	V (3)	III (1)		
Cladonia foliacea	III (2-3)	V (2-3)		IV (1-3)	
Cladonia uncialis	III (2-5)				
Cladonia furcata	II (2-3)			III (1-3)	
Cladonia squamosa	II (2-3)	III (1-2)			
Cladonia gracilis	II (2-3)	V (3-4)			
Ptilidium ciliare	II (2-6)				
Pohlia nutans	II (1-4)				
Cladonia fimbriata	II (3-4)				
Cladonia pyxidata	II (3-4)				
Campylopus introflexus	I (3-8)		IV (1-2)		
Brachythecium albicans	I (4-5)				
Holcus lanatus	I (3-4)		IV (1-2)		IV (1)
Galium saxatile	I (2)				
Hieracium pilosella	I (3)			III (3)	
Senecio jacobaea	I (2)			I (1)	II (1)
Koeleria macrantha	II (3-4)			III (1-3)	
Hypnum cupressiforme s.l.	II (2-8)				
Calluna vulgaris	I (2)				
Ceratodon purpureus	I (1-2)	I (3)			
Polytrichum juniperinum	II (3-4)		V (8-10)	I (3)	
Pseudoscleropodium purum	I (5)				
Pteridium aquilinum	I (2-3)				
Rhytidiadelphus squarrosus	I (2)				
Epilobium angustifolium	I (2)		III (2)		
Pleurozium schreberi	I (2)				
Aira praecox		I (1)		V (3-4)	IV (1-2)
Cerastium fontanum					
Teesdalia nudicaulis		I (3)			
Aphanes arvensis					
Myosotis ramosissima					
Trifolium dubium					
Arenaria serpyllifolia					
Anthoxanthum odoratum		I (2)			
Lotus corniculatus					
Plantago lanceolata					
Ulex europaeus seedlings					
Hypochoeris radicata			V (1-2)		
Centaureum erythraea					
Leontodon taraxacoides					
Festuca rubra					
Umbilicaris rupestris					
Sedum anglicum					
Lychnis viscaria					
Veronica spicata					
Hieracium peleteranum					
Taraxacum officinale egg.					
Poa annua					IV (1-3)
Plantago coronopus					
Peltigera canina					

	1	2	3	4	5
Agrostis stolonifera					
Anthyllis vulneraria					
Trifolium repens					
Ornithopus perpusillus					
Sagina procumbens					
Bromus hordeaceus					
subsp. hordeaceus					
Bromus sterilis					
Cuscuta epithymum					I (3)
Cladonia verticillata		V (2-4)	I (1)		
Jasione montana					IV (1-4)
Cladonia floerkeana			III (1-3)		
Cytisus scoparius (ground)					
Cytisus scoparius (shrub)					
Cladonia chlorophaea agg.		V (1-3)	V (3)		
Hypogymnia physodes		V (3)	V (1-3)		
Festuca tenuifolia			III (2-3)	V (3-4)	IV (1-2)
Silene nutans				III (1-3)	
Teucrium scorodonia		I (3)	V (1-2)		III (1)
Cladonia rangiformis				V (1-4)	
Rumex acetosa					
Silene vulgaris subsp. maritima			I (1)		III (2-3)
Bryum capillare					
Poa compressa					
Vicia hirsuta					
Peltigera polydactyla					
Cladonia polydactyla					
Digitalis purpurea					V (5)
Campylopus paradoxus		V (2)			
Eurhynchium praelongum					
Ranunculus repens					
Urtica dioica					
Rubus fruticosus agg.			III (1)		
Sonchus arvensis					
Potentilla reptans					
Cerastium diffusum subsp. diffusum					
Dipsacus fullonum					
Plantago lanceolata					
Vicia sativa					
Arrhenatherum elatius					
Rumex crispus					
Galium mollugo					
Galium aparine					
Plantago media					
Dicranoweisia cirrata					
Grimmia pulvinata					
Parmelia saxatilis					
Vulpia bromoides					
Evernia prunastri		I (1)			
Leontodon autumnalis					
Barbula cylindrica					
Sonchus asper					
Armeria maritima				I (2)	
Cirsium vulgare					III (1)
Sedum acre					
Atriplex glebriuscula					
Parmelia sulcata		I (1)			
Atriplex patula					
Carlina vulgaris					
Campylopus pyriformis					
Hypogymnia tubulosa					
Parmelia caperata					
Beta vulgaris subsp. maritima					
Cladonia macilenta		I (2)	IV (1-3)		
Cladonia coniocraea		I (1)			
Lecidia granulosa		I (3)			
Xanthoria parietina		I (1)			
Betula pubescens seedling			I (1)		
Cladonia coccifera			V (1-3)		
Cladonia subulata			IV (1-3)		
Juncus effusus			I (1)		

	1	2	3	4	5
<i>Cladonia crispata</i>			I (1)		
<i>Platismatia glauca</i>			I (1)		
<i>Cirsium arvense</i>					III (1)
<i>Corydalis claviculata</i>					III (3)
<i>Veronica chamaedrys</i>					II (1)
No of samples	18	4	4	4	4
No of species/sample	14(7-20)	13(10-17)	14(11-16)	10(8-13)	8(6-10)

LIST 4. A2F *Festuca rubra* grassland compared with NVC/MCS: *Festuca rubra*-*Armeria maritima* (cliff) grassland: typical sub-community, and with NVC/MCS: *Armeria maritima*-*Cerastium diffusum* subsp. *diffusum* maritime therophyte community.

- 1 NVC/MCSa *Festuca rubra*-*Armeria maritima* maritime (cliff) grassland: typical sub-community
 2 NVC/MCS *Armeria maritima*-*Cerastium diffusum* subsp. *diffusum* maritime therophyte community
 3 Dungeness A2F

	1	2	3
<i>Festuca rubra</i>	V (7-10)	IV (2-8)	V (5-8)
<i>Armeria maritima</i>	V (1-5)	V (2-8)	III (3)
<i>Agrostis stolonifera</i>	III (1-5)	I (1-5)	
<i>Daucus carota</i> subsp. <i>gummifer</i>	II (1-5)	II (1-4)	I (1)
<i>Beta vulgaris</i> subsp. <i>maritima</i>	I (1-4)	I (1-5)	
<i>Holcus lanatus</i>	I (1-3)	II (1-8)	
<i>Rumex acetosa</i>	I (1-3)		II (1)
<i>Cirsium arvense</i>	I (1)		I (2)
<i>Plantago coronopus</i>	I (1-4)	V (1-8)	II (1-3)
<i>Plantago maritima</i>	II (1-7)	I (1-5)	
<i>Cerastium diffusum</i>			
subsp. <i>diffusum</i>	I (1)	IV (1-5)	II (1-3)
<i>Tortella flavovirens</i>	I (3)	I (2-4)	
<i>Eurhynchium praelongum</i>	I (2)		I (1)
<i>Anthyllis vulneraria</i>	I (1-5)	II (1-8)	
<i>Sagina maritima</i>		I (2-3)	
<i>Sonchus oleraceus</i>	I (1-3)	I (1-3)	
<i>Lotus corniculatus</i>	II (1-4)	II (1-5)	IV (2-8)
<i>Trifolium repens</i>	I (2-4)	I 2-3)	I (1)
<i>Cochlearia officinalis</i>	II (1-4)		
<i>Matricaria maritima</i>	I (1-2)	I (1-3)	
<i>Plantago lanceolata</i>	I (1-3)	II (1-5)	II (3)
<i>Spergularia rupicola</i>	I (1-2)	II (1-6)	
<i>Cerastium fontanum</i>	I (1-3)	I (1-2)	
<i>Hypochoeris radicata</i>	I (1-3)		II (1)
<i>Scilla verna</i>	I (1-3)	I (1-4)	
<i>Dactylis glomerata</i>	I (1-3)	II (1-6)	
<i>Leontodon autumnalis</i>	I (2-4)	I (1)	
<i>Poa subcaerulea</i>	I (3-5)		
<i>Cochlearia danica</i>	I (1)	I (1-5)	
<i>Angelica sylvestris</i>	I (4)		
<i>Leontodon taraxacoides</i>	I (1-3)	II (1-4)	I (1)
<i>Desmazeria marina</i>		III (1-8)	
<i>Sagina maritima</i>		I (2-3)	
<i>Radiola linoides</i>		I (1-2)	
<i>Collema</i> sp.		I (2)	
<i>Cochlearia officinalis</i>		I (1-2)	
<i>Sedum anglicum</i>		III (1-9)	II (1-3)
<i>Herniaria ciliolata</i>		I (1-5)	
<i>Trifolium arvense</i>		I (1-4)	I (4)
<i>Trifolium occidentale</i>		I (2-4)	
<i>Aira praecox</i>		III (1-7)	
<i>Festuca ovina</i>		II (3-9)	
<i>Cladonia foliacea</i>		II (2-6)	I (3)
<i>Jasione montana</i>		I (1-4)	
<i>Aira caryophyllea</i>		I (1-4)	
<i>Cladonia rangiformis</i>		I (1-6)	IV (2-4)
<i>Hypnum cupressiforme</i>		I (2-5)	I (3)
<i>Agrostis capillaris</i>		I (1-4)	I (1)
<i>Scilla autumnalis</i>		I (2-5)	
<i>Cladonia chlorophaea</i> agg.		I (2-4)	
<i>Sagina apetala</i> subsp. <i>apetala</i>		I (1-4)	
<i>Arenaria serpyllifolia</i>		I (1-4)	I (1)
<i>Sedum acre</i>		I (2-7)	III (1-4)
<i>Bromus hordeaceus</i> subsp. <i>ferronii</i>		III (1-6)	
<i>Thymus praecox</i>		II (1-8)	
<i>Desmazeria rigida</i>		I (2-4)	I (1)
<i>Echium vulgare</i>		I (1-2)	
<i>Hieracium pilosella</i>		I (2-4)	II (1-4)

	1	2	3
<i>Salvia hominoides</i>		I (1-5)	
<i>Taraxacum</i> sp.		I (1-3)	
<i>Myosotis ramosissima</i>		I (2-4)	
<i>Euphorbia portlandica</i>		I (1-3)	
<i>Festuca arundinacea</i>		I (2-3)	I (1)
<i>Hippocrepis comosa</i>		I (2-4)	
<i>Diploaxis muralis</i>		I (2-3)	
<i>Cirsium acaule</i>		I (1-2)	
<i>Filipendula vulgaris</i>		I (2-3)	
<i>Senecio jacobaea</i>		I (2-3)	I (1)
<i>Ranunculus acris</i>		I (2)	
<i>Vicia sativa</i>		I (1-2)	II (2-3)
<i>Brassica oleracea</i>		I (1-4)	
<i>Veronica arvensis</i>		I (2-4)	
<i>Achillea millefolium</i>		I (1-3)	
<i>Brachypodium pinnatum</i>		I (3-4)	
<i>Sanguisorba minor</i>		I (3-5)	
<i>Senecio vulgaris</i>		I (1-3)	
<i>Reseda lutea</i>		I (1-2)	
<i>Carex flacca</i>		I (2)	
<i>Atriplex littoralis</i>		I (2-4)	
<i>Koeleria macrantha</i>		II (2-6)	I (4)
<i>Bellis perennis</i>		I (2-3)	
<i>Galium verum</i>		I (1-5)	
<i>Lolium perenne</i>		I (2)	
<i>Centaureum erythraea</i>		I (1-3)	
<i>Trifolium scabrum</i>		I (2-4)	II (1-3)
<i>Erodium cicutarium</i>		I (2-4)	
<i>Galium mollugo</i>			II (1-3)
<i>Arrhenatherum elatius</i>			I (1)
<i>Cerastium fontanum</i>			III (3)
<i>Peltigera polydactyla</i>			I (2)
<i>Homalothecium lutescens</i>			II (1)
<i>Brachythecium albicans</i>			III (1-4)
<i>Veronica agrestis</i>			I (1)
<i>Poa compressa</i>			III (1-5)
<i>Medicago lupulina</i>			I (2)
<i>Arenaria leptoclados</i>			I (1)
<i>Bromus hordeaceus</i> subsp. <i>thominii</i>			I (1)
<i>Ceratodon purpureus</i>			II (2)
<i>Bryum capillare</i>			II (1-3)
<i>Sonchus asper</i>			I (1)
<i>Silene vulgaris</i> subsp. <i>maritima</i>			III (1-3)
<i>Anthoxanthum odoratum</i>			I (2)
<i>Cladonia furcata</i>			I (1)
<i>Cladonia ciliata</i>			II (2-3)
<i>Bromus hordeaceus</i> subsp. <i>hordeaceus</i>			I (4)
No of samples	120	193	5
No of species/sample	6(2-10)	14(5-20)	17 (7-22)

LIST 5. B1 mesotrophic vegetation compared with MVC/Ufd: *Festuca ovina*-*Agrostis capillaris*-*Rumex acetosella* calcifuge grassland, *Anthoxanthum odoratum*-*Lotus corniculatus* sub-community.

- 1 MVC/Ufd *Festuca ovina*-*Agrostis capillaris*-*Rumex acetosella* grassland,
Anthoxanthum odoratum-*Lotus corniculatus* sub-community
2 Dungeness B1 (i)
3 Dungeness B1 (ii)
4 Dungeness B1 (iii)

	1	2	3	4
<i>Festuca ovina</i>	V (3-9)	I (5)	I (5)	III (1)
<i>Agrostis capillaris</i>	IV (3-6)	IV (2-5)	II (1-3)	III (2)
<i>Rumex acetosella</i>	IV (3-7)	III (1-4)	II (1)	V (2)
<i>Dicranum scoparium</i>	II (3-8)		III (1-3)	III (5)
<i>Polytrichum piliferum</i>	I (3-5)			
<i>Cladonia arbuscula</i>	I (6)			
<i>Cladonia squamosa</i>	I (3-4)			
<i>Cladonia gracilis</i>	I (3)			
<i>Ptilidium ciliare</i>	I (3)			
<i>Aira praecox</i>	I (3-4)		II (1)	V (1)
<i>Erodium cicutarium</i>	I (3-4)			
<i>Cerastium fontanum</i>	II (3-4)	I (2)	III (1-3)	III (3)
<i>Teesdalia nudicaulis</i>	I (3)			
<i>Aphanes arvensis</i>	I (3-4)			
<i>Myosotis ramosissima</i>	I (3)			
<i>Erophila verna</i>	I (3-4)			
<i>Astragalus danicus</i>	I (3)			
<i>Veronica arvensis</i>	I (3)			
<i>Trifolium dubium</i>	I (3-4)			
<i>Ornithopus perpusillus</i>	I (3)			
<i>Plantago media</i>	I (3-4)			
<i>Cerastium arvensis</i>	I (3)			
<i>Trifolium sp.</i>	I (3)			
<i>Tortula ruralis</i> subsp. <i>ruraliformis</i>	I (4)			
<i>Anthoxanthum odoratum</i>	IV (3-5)	I (4)	III (4-5)	III (4)
<i>Lotus corniculatus</i>	IV (3-5)	I (4)	III (1-7)	V (4)
<i>Galium verum</i>	IV (3-5)			
<i>Plantago lanceolata</i>	IV (3-4)	V (3-4)	IV (1-2)	V (4)
<i>Holcus lanatus</i>	III (3-4)	I (1)	II (1)	
<i>Achillea millefolium</i>	III (3-5)			
<i>Campanula rotundifolia</i>	II (2-4)			
<i>Quercus robur</i> seedling	II (2-3)			
<i>Galium saxatile</i>	I (4)			
<i>Ulex europaeus</i>	I (2-4)			
<i>Hypochoeris radicata</i>		II (1-2)	I (1)	III (1)
<i>Centaurium erythraea</i>			I (1)	
<i>Leontodon taraxacoides</i>	I (3-4)			
<i>Festuca rubra</i>		V (4-6)	IV (2-7)	III (1)
<i>Kieracium pilosella</i>	III (3-8)	III (1-2)	II (1-2)	V (2-3)
<i>Koeleria macrantha</i>	II (3-4)	I (1)		
<i>Hypnum cupressiforme</i> s.l.	II (3-6)	II (1-2)	III (1-2)	III (3)
<i>Taraxacum officinale</i> agg.	II (3)			
<i>Calluna vulgaris</i>	II (2-4)			
<i>Poa annua</i>	I (3-5)	I (1)		
<i>Ceratodon purpureus</i>	I (3-4)			
<i>Polytrichum juniperinum</i>	I (3)			
<i>Plantago coronopus</i>	I (3-4)	I (1)	I (1)	
<i>Peltigera canina</i>	II (3-4)	I (2)		
<i>Carex arenaria</i>	II (3-7)			
<i>Pteridium aquilinum</i>	I (3)			
<i>Rhytidiadelphus squarrosus</i>	I (3-6)			
<i>Agrostis stolonifera</i>	I (5)		II (1)	
<i>Epilobium angustifolium</i>	I (2-4)			
<i>Luzula campestris</i>	I (3-6)			
<i>Veronica chamaedris</i>	I (3)			
<i>Anthyllis vulneraria</i>	I (3)			
<i>Trifolium repens</i>	I (3-4)			
<i>Spergularia rubra</i>	I (3)			
<i>Stellaria media</i>	I (3)			

	1	2	3	4
Crassula tillaea	I (5)			
Glechoma hederacea	I (2)			
Bilderdykia convolvulus	I (3-5)			
Senecio vulgaris	I (3-5)			
Bromus hordeaceus				
subsp. hordeaceus		I (3)	I (2)	
Phleum pratense	I (3)			
Potentilla argentea	I (2-3)			
Reseda lutea	I (3)			
Stellaria graminea	I (3)			
Rumex crispus			II (1-2)	
Galium mollugo				III (3)
Arrhenatherum elatius		II (1)	III (1-3)	
Senecio viscosus			I (1)	
Vicia sativa	I (3-5)	V (2-3)	IV (1-3)	
Peltigera polydactyla			II (1-2)	
Homalothecium lutescens		I (4)	II (1-2)	
Barbula unguiculata		II (1)		
Vulpia bromoides		IV (2-3)	III (1-5)	V (2-4)
Vicia lathyroides				III (1)
Veronica agrestis		III (1-2)	II (1)	
Trisetum flavescens		III (2-5)	IV (1-6)	
Trifolium striatum		III (2-4)		V (2-3)
Trifolium scabrum		III (1-3)		III (1)
Trifolium repens			III (2-5)	
Trifolium campestre	I (4)	I (4)	I (1)	III (1)
Trifolium arvense		I (1)		III (1)
Taraxacum sect. vulgare		IV (1-2)		III (1)
Sedum acre	I (3-4)	I (2)	III (1-4)	
Poa compressa		V (2-5)	IV (1-4)	III (4)
Medicago lupulina		III (3-5)	IV (1-4)	
Medicago arabica		II (1-4)		
Lolium perenne		V (1-2)	II (1-3)	III (6)
Glaucium flavum			II (2-5)	
Geranium molle	I (3-4)	II (2-3)	II (1)	
Geranium dissectum			II (1)	
Echium vulgare		IV (2-4)	III (1-4)	
Dipsacus fullonum			II (2-3)	
Dactylis glomerata	I (2-4)	IV (1-5)	IV (1-3)	
Crepis capillaris		II (1)		
Convolvulus arvensis		I (4)		III (1)
Cirsium arvense		I (1)		
Cerastium diffusum subsp. diffusum		IV (1-2)		III (1)
Centaurea nigra			II (1-2)	
Desmazeria rigida		III (1)		
Carduus tenuifolius		I (2)	III (1-6)	
Bromus hordeaceus subsp. thominii		V (1-5)		V (3-4)
Arenaria serpyllifolia	I (3-6)	III (1-3)	II (2-4)	
Anthriscus caucalis			II (1-3)	
Achillea millefolium		V (2-4)	IV (1-2)	III (5)
Rubus fruticosus agg.	I (4)		V (1-5)	
Ceratodon purpureus		I (1)		III (2)
Bryum capillare		I (1)		III (1)
Vicia hirsuta		IV (2-4)	II (1)	III (1)
Brachythecium albicans	II (3-6)	V (1-2)	II (1-3)	III (3)
Urtica dioica	I (3-4)		II (1-3)	
Sonchus asper			II (1)	
Sonchus arvensis			II (2-3)	
Senecio jacobaea	III (1-5)	V (1-3)	V (1-3)	
Sagina procumbens			I (1)	
Ranunculus repens			I (1)	
Potentilla reptans	I (3)	II (1-4)	III (1-4)	
Lophocolea bidentata			II (1)	
Cirsium vulgare			II (1)	
Eurhynchium praelongum			I (1)	III (2)
Brachythecium rutabulum		I (1)	II (1)	
Rumex acetosa	I (3)	I (1)	III (1-3)	III (1)
Parmelia sulcata		I (1)		
Teucrium scorodonia	I (3-5)		V (1-5)	III (1)
Cladonia rangiformis			I (2)	

	1	2	3	4
<i>Cladonia furcata</i>	I (3-4)		I (1)	
<i>Cladonia foliacea</i>	I (3)	I (1)	II (1)	
<i>Silene nutans</i>		I (4)	II (1-4)	III (2)
<i>Festuca tenuifolia</i>		I (4)	III (1-4)	V (4-5)
<i>Cuscuta epithymum</i>			II (1)	
<i>Cladonia ciliata</i>		I (4-5)	II (1-2)	
<i>Polytrichum juniperinum</i>			I (3)	III (1)
<i>Sedum anglicum</i>			I (1)	
<i>Daucus carota</i>		I (1)		
<i>Cerastium arvense</i>		I (3)	I (2)	
<i>Carex spicata</i>			I (1)	
<i>Pseudoscleropodium purum</i>	II (2-7)			I (1)
<i>Vulpia ciliata</i> subsp. <i>ambigua</i>		I (1)		
<i>Moenchia erecta</i>		I (1)		
<i>Collinsia</i> sp.		I (1)		
<i>Bryum argenteum</i>		I (1)		
<i>Trifolium dubium</i>		I (1)		
<i>Tragopogon pratensis</i>		I (1)		
<i>Senecio sylvaticum</i>			I (1)	
<i>Sagina apetala</i> subsp. <i>apetala</i>		I (1)		
<i>Ranunculus bulbosus</i>		I (1)		
<i>Papaver rhoeas</i>		I (1)		
<i>Holcus mollis</i>		I (1)		
<i>Erodium cicutarium</i>		I (2)		
<i>Tanacetum vulgare</i>		I (4)		
<i>Cerastium semidecandrum</i>		I (2)		
No. of samples	29	6	9	2
No. of species/sample	17(6-28)	27(22-38)	25(119-28)	24(20-27)

LIST 6. B2 wetland vegetation compared with WVC/W1: *Salix cinerea*-*Galium palustre* woodland, and with WVC/W24: *Rubus fruticosus* agg.-*Holcus lanatus* underscrub.

- 1 WVC/W1: *Salix cinerea*-*Galium palustre* woodland
 2 WVC/W24: *Rubus fruticosus* agg.-*Holcus lanatus* underscrub
 3 Dungeness B2 (i)
 4 Dungeness B2 (ii)

	1	2	3	4
<i>Salix cinerea</i>	V (4-10)			
<i>Betula pubescens</i>	II (3-7)			
<i>Quercus robur</i>	I (4-5)			
<i>Betula pendula</i>	I (4-7)			
<i>Crataegus monogyna</i>	I (1-5)	II (1-5)		
<i>Alnus glutinosa</i>	I (4)			
<i>Frangula alnus</i>	I (4-8)			
<i>Corylus avellana</i>	I (3-5)	I (4)		
<i>Salix viminalis</i>	I (6)			
<i>Salix purpurea</i>	I (5)			
<i>Betula pubescens</i> seedlings	I (2-4)	I (5)		
<i>Quercus robur</i> seedlings	I (1-3)	I (2-3)		
<i>Alnus glutinosa</i> seedlings	I (3-9)			
<i>Galium palustre</i>	IV (1-4)		II (1)	V (1-3)
<i>Juncus effusus</i>	III (1-6)			
<i>Mentha aquatica</i>	III (1-6)			
<i>Holcus lanatus</i>	II (3-6)	IV (2-8)		III (4-9)
<i>Eurhynchium praelongum</i>	II (1-6)			III (1)
<i>Angelica sylvestris</i>	II (2-5)			
<i>Rubus fruticosus</i> agg.	II (1-6)	V (1-5)	V (9-10)	III (4)
<i>Ranunculus flammula</i>	II (1-6)			
<i>Solanum dulcamara</i>	II (1-7)	I (1-4)	IV (1)	II (1)
<i>Lycopus europaeus</i>	II (1-6)			
<i>Ranunculus repens</i>	II (1-6)	I (1-4)	V (1-3)	IV (1-5)
<i>Equisetum fluviatile</i>	II (1-4)			
<i>Hedera helix</i>	II (1-6)	II (1-4)		
<i>Epilobium palustre</i>	II (2-4)			II (2)
<i>Agrostis canina</i>				
subsp. <i>canina</i>	I (3-7)			
<i>Filipendula ulmaria</i>	I (1-8)			
<i>Cirsium palustre</i>	I (3-4)	I (2-3)		
<i>Agrostis stolonifera</i>	I (1-7)	II (1-8)		
<i>Rumex sanguineus</i>	I (1-4)			
<i>Hydrocotyle vulgaris</i>	I (3-4)			III (1-2)
<i>Potentilla palustris</i>	I (1-5)			
<i>Chiloscyphus polyanthos</i>	I (1-4)			
<i>Caltha palustris</i>	I (4-8)			
<i>Phragmites australis</i>	I (2-4)	I (4-6)		
<i>Molinia caerulea</i>	I (4-8)			
<i>Iris pseudacorus</i>	I (1-4)			
<i>Dryopteris carthusiana</i>	I (4-6)			
<i>Rumex acetosa</i>	I (1-4)			II (2)
<i>Cardamine flexuosa</i>	I (1-3)			
<i>Lotus pedunculatus</i>	I (3-4)			
<i>Carex remota</i>	I (1-5)			
<i>Rhytidadelphus squarrosus</i>	I (1-3)			
<i>Calliargon cuspidatum</i>	I (1-4)			II (1)
<i>Carex paniculata</i>	I (1-8)			
<i>Brachythecium rutabulum</i>	I (3-5)			
<i>Lychnis flos-cuculi</i>	I (4-5)			
<i>Lonicera periclymenum</i>	I (2-4)			
<i>Juncus acutiflorus</i>	I (3-8)			
<i>Plagiomnium undulatum</i>	I (1-4)			
<i>Thuidium tamariscinum</i>	I (1-5)			
<i>Lophocolea bidentata</i> s.l.	I (2-4)			
<i>Callitriche stagnalis</i>	I (2-6)			
<i>Equisetum palustre</i>	I (2-5)			
<i>Calliargon cordifolium</i>	I (3-4)			
<i>Galium uliginosum</i>	I (3-5)			
<i>Valeriana officinalis</i>	I (3)			

	1	2	3	4
<i>Agrostis capillaris</i>	I (2-4)			
<i>Dactylis glomerata</i>	I (3-4)	III (1-7)		
<i>Myosotis scorpioides</i>	I (2-3)			
<i>Carex riparia</i>	I (1-8)			
<i>Phalaris arundinacea</i>	I (5-6)	I (3-4)		
<i>Lemna minor</i>	I (3-4)			
<i>Apium nodiflorum</i>	I (4-5)			
<i>Glyceria fluitans</i>	I (1-4)			
<i>Galium aparine</i>	I (2-3)	III (1-6)		
<i>Carex nigra</i>	I (2-4)			
<i>Fraxinus excelsior</i> seedlings		I (4-7)		
<i>Acer pseudoplatanus</i> seedlings		I (1-4)		
<i>Fagus sylvatica</i> seedlings		I (1-5)		
<i>Sambucus nigra</i>		I (1-4)		
<i>Prunus spinosa</i>		I (1-3)		
<i>Cirsium arvense</i>		II (1-4)		
<i>Cirsium vulgare</i>		II (1-4)		
<i>Epilobium angustifolium</i>		II (1-8)		II (1)
<i>Glechoma hederacea</i>		II (1-4)		
<i>Prunella vulgaris</i>		I (1-5)		
<i>Silene dioica</i>		I (2-5)		
<i>Digitalis purpurea</i>		I (1-6)		
<i>Brachythecium rutabulum</i>		I (1-4)		
<i>Fragaria vesca</i>		I (2-5)		
<i>Epilobium hirsutum</i>		I (3-5)	II (1)	
<i>Ulex europaeus</i>		I (2-5)		
<i>Senecio jacobaea</i>		I (1-3)		V (1-4)
<i>Urtica dioica</i>		III (1-9)	II (1)	IV (1-4)
<i>Arrhenatherum elatius</i>		III (1-7)		
<i>Heracleum sphondylium</i>		III (1-6)		
<i>Taraxacum officinale</i> agg.		II (1-4)		
<i>Festuca rubra</i>		II (1-7)		
<i>Anthriscus sylvestris</i>		II (2-5)		
<i>Achillea millefolium</i>		II (1-3)		
<i>Chaerophyllum temulentum</i>		II (2-5)		
<i>Cruciata laevipes</i>		II (1-4)		
<i>Poa pratensis</i>		I (1-7)		
<i>Elymus repens</i>		I (2-3)		
<i>Potentilla sterilis</i>		I (1-4)		
<i>Dryopteris filix-mas</i>		I (1-3)		
<i>Vicia sepium</i>		I (2)		
<i>Vicia sativa</i> subsp. <i>nigra</i>		I (1-4)		
<i>Lathyrus pratensis</i>		I (2-6)		
<i>Filipendula ulmaria</i>		I (2-5)		
<i>Stellaria holostea</i>		I (4-7)		
<i>Lapsana communis</i>		I (1-2)		
<i>Ranunculus ficaria</i>		I (5-6)		
<i>Alliaria petiolata</i>		I (1-4)		
<i>Poa trivialis</i>		II (1-6)		
<i>Brachypodium sylvaticum</i>		II (1-7)		
<i>Geranium robertianum</i>		II (1-3)		
<i>Geum urbanum</i>		II (1-4)		
<i>Mercurialis perennis</i>		II (2-4)		
<i>Veronica chamaedrys</i>		I (2-4)		
<i>Ranunculus acris</i>		I (1-4)		
<i>Viola riviniana</i>		I (1-4)		
<i>Equisetum arvense</i>		I (1-2)		
<i>Hypochoeris radicata</i>		I (1-4)		
<i>Anthoxanthum odoratum</i>		I (3-4)	II (1)	
<i>Lolium perenne</i>		I (1-4)		
<i>Rosa canina</i> agg.		I (2-4)		
<i>Bromus sterilis</i>		I (2-7)		
<i>Stachys sylvatica</i>		I (2-3)		
<i>Deschampsia cespitosa</i>		I (2-5)		
<i>Trisetum flavescens</i>		I (1-4)		
<i>Centaurea nigra</i>		I (2-4)		
<i>Trifolium repens</i>		I (2-4)		II (2)
<i>Arum maculatum</i>		I (4)		
<i>Solidago virgaurea</i>		I (3-5)		

	1	2	3	4
<i>Pseudocleropodium purum</i>		I (1-4)		II (1)
<i>Epilobium montanum</i>		I (1-3)		
<i>Hypnum cupressiforme</i>		I (1-5)	II (1)	
<i>Drabaegus monogyna</i> seedlings		I (1-2)		
<i>Lotus corniculatus</i>		I (1-4)		IV (1-2)
<i>Rumex crispus</i>			II (1)	II (1)
<i>Galium mollugo</i>			II (1)	
<i>Senecio viscosus</i>				III (2-4)
<i>Cerastium fontanum</i>				III (1-2)
<i>Peltigera polydactyla</i>				II (1)
<i>Vulpia bromoides</i>				II (1)
<i>Sedum acre</i>			II (1)	
<i>Poa compressa</i>			II (2)	III (3)
<i>Ceratodon purpureus</i>				II (1)
<i>Bryum capillare</i>			II (1)	
<i>Sonchus asper</i>			II (1)	III (1-2)
<i>Sagina procumbens</i>				IV (1-2)
<i>Potentilla reptans</i>			V (1)	II (7)
<i>Mentha aquatica</i>				III (1-2)
<i>Lythrum salicaria</i>				V (2-5)
<i>Linaria vulgaris</i>			IV (1)	
<i>Epilobium adenocaulon</i>				III (4)
<i>Anagallis arvensis</i>				II (1)
<i>Agrostis stolonifera</i>				III (1-5)
<i>Cardamine hirsuta</i>				III (1-3)
<i>Teucrium scorodonia</i>			IV (3-4)	III (1-4)
<i>Cladonia chlorophaea</i> agg.				III (1)
<i>Dicranum scoparium</i>			IV (1)	
<i>Rumex acetosella</i>			II (1)	
<i>Festuca tenuifolia</i>				II (2)
<i>Sedum anglicum</i>				II (1)
<i>Carex spicata</i>				II (1)
<i>Salix arenaria</i>				II (2)
<i>Mnium hornum</i>				II (2)
<i>Viola riviniana</i>				II (1)
<i>Veronica serpyllifolia</i>				II (1)
<i>Rumex conglomeratus</i>				II (2)
<i>Rubus caesius</i>				II (4)
<i>Prunella vulgaris</i>				II (1)
<i>Myosotis laxa</i> subsp. <i>caespitosa</i>				II (2)
<i>Linum catharticum</i>				II (1)
<i>Leontodon taraxacoides</i>				II (2)
<i>Epilobium tetragonum</i>				II (1)
<i>Cerastium glomeratum</i>				II (2)
<i>Carex nigra</i>				II (1)
<i>Barbarea vulgaris</i>				II (1)
<i>Agrimonia procera</i>			II (4)	
No of samples	38	39	3	4
No of species/sample	17(3-32)	18(8-39)	10(6-13)	21(17-25)

LIST 7. B3 Arrhenatherum elatius grassland compared with NVC/MG1a: Arrhenatheretum elatioris, Festuca rubra sub-community.

- 1 NVC/MG1a: Arrhenatherum elatioris, Festuca rubra sub-community
- 2 Dungeness B3 (i)
- 3 Dungeness B3 (ii)

	1	2	3
Arrhenatherum elatius	V (2-9)	V (5-8)	V (1-7)
Dactylis glomerata	IV (2-8)		
Holcus lanatus	II (2-8)		
Heracleum spondylium	III (11-6)		
Anthriscus sylvestris	II (1-7)		
Agrostis stolonifera	II (2-6)		
Achillea millefolium	II (1-5)		
Plantago lanceolata	III (1-5)		
Festuca rubra	III (1-9)		III (3-7)
Centaurea nigra	II (1-6)		
Cirsium arvense	III (1-5)		
Poa pratensis	II (1-6)		
Poa trivialis	II (2-8)		
Lathyrus pratensis	II (1-7)		
Elymus repens	II (2-8)		
Lolium perenne	II (1-8)		
Rubus fruticosus agg.	II (2-6)	IV (1-7)	
Taraxacum officinale agg.	II (1-5)		I (1)
Vicia sativa subsp. nigra	II (2-4)		III (1-3)
Brachythecium rutabulum	II (1-7)	II (1-3)	I (1)
Rumex crispus	I (2)	IV (1-3)	II (1-3)
Galium mollugo	I (3-4)	IV (1-3)	IV (1-4)
Cerastium fontanum	I (1-4)	III (1-3)	II (2-3)
Senecio jacobaea	I (2-3)	III (1)	III (1-2)
Ranunculus repens	I (1-6)	II (2-3)	
Potentilla reptans	I (1-7)	III (1-3)	
Rumex acetosa	I (1-3)	IV (1-5)	III (1-4)
Hypochaeris radicata	I (2)	I (1)	III (1-4)
Lotus corniculatus	I (2-5)	II (1)	
Urtica dioica	I (1-3)		I (1)
Festuca ovina	I (2-5)		I (1)
Agrostis capillaris	I (2-8)	I (4)	
Eurhynchium praelongum	I (2-7)		I (2)
Lamium album	I (3-4)		
Papaver rhoeas	I (2)		
Papaver dubium	I (1)		
Capsella bursa-pastoris	I (3-4)		
Sonchus asper	I (3)		
Aegopodium podagraria	I (5)		
Galium aparine	I (1-5)		
Pastinaca sativa	I (2)		
Galium verum	I (2-7)		
Knautia arvensis	I (3-4)		
Sanguisorba minor	I (1-4)		
Prunella vulgaris	I (5)		
Agrimonia eupatoria	I (1-3)		
Clinopodium vulgare	I (2-3)		
Centaurea scabiosa	I (1-7)		
Trisetum flavescens	I (3-4)		
Veronica chamaedrys	I (1-4)		
Leucanthemum vulgare	I (3-6)		
Trifolium pratense	I (3-7)		
Hypericum perforatum	I (2-8)		
Trifolium repens	I (2-4)		
Pseudoscleropodium purum	I (3)		
Pteridium aquilinum	I (2-3)		
Plantago media	I (4-8)		
Ranunculus acris	I (1-4)		
Vicia cracca	I (2-4)		
Bromus sterilis	I (1-8)		
Brachypodium sylvaticum	I (2-5)		
Convolvulus arvensis	I (2-6)		

	1	2	3
<i>Cynosurus cristatus</i>	I (2-8)		
<i>Glechoma hederacea</i>	I (1-4)		
<i>Pteridium aquilinum</i>	I (3-6)		
<i>Lotus uliginosus</i>	I (2)		
<i>Leontodon hispidus</i>	I (3)		
<i>Festuca pratensis</i>	I (1-3)		
<i>Stellaria graminea</i>	I (2-3)		
<i>Ranunculus ficaria</i>	I (1-4)		
<i>Vicia sepium</i>	I (3-4)		
<i>Epilobium angustifolium</i>	I (2-6)		
<i>Phleum pratense</i>			
subsp. <i>pratense</i>	I (3-4)		
<i>Cirsium vulgare</i>	I (3-5)		
<i>Rhinanthus minor</i>	I (2)		
<i>Phleum pratense</i>			
subsp. <i>bertolonii</i>	I (2-3)		
<i>Carduus nutans</i>	I (4)		
<i>Luzula campestris</i>	I (1)		
<i>Holcus mollis</i>	I (3-4)		
<i>Ranunculus bulbosus</i>	I (3)		
<i>Daucus carota</i> subsp. <i>carota</i>	I (3-4)		
<i>Bromus hordeaceus</i>			
subsp. <i>hordeaceus</i>	I (1-4)		
<i>Geranium dissectum</i>	I (2-5)		
<i>Hedera helix</i>	I (3-5)		
<i>Rumex obtusifolius</i>	I (1-4)		
<i>Conopodium majus</i>	I (3)		
<i>Pimpinella major</i>	I (4)		
<i>Senecio viscosus</i>		II (1-2)	III (1)
<i>Hypnum cupressiforme</i> var. <i>cupressiforme</i>		III (1-4)	II (1-3)
<i>Hypnum cupressiforme</i> var. <i>lacunosum</i>		III (1-4)	I (2-3)
<i>Ceratodon purpureus</i>		II (2-3)	I (1-3)
<i>Bryum capillare</i>		II (2-3)	I (1-3)
<i>Vicia hirsuta</i>		II (2-3)	III (1-3)
<i>Sagina procumbens</i>		II (1)	
<i>Silene vulgaris</i> subsp. <i>maritima</i>			III (3-5)
<i>Teucrium scorodonia</i>		IV (1-4)	I (1)
<i>Anthoxanthum odoratum</i>		II (2-3)	I (1)
<i>Cladonia chlorophaea</i> agg.		II (1-3)	III (1)
<i>Hypogymnia physodes</i>		II (1-2)	II (1-3)
<i>Cladonia foliacea</i>		II (1-3)	I (1)
<i>Dicranum scoparium</i>		IV (1-3)	I (1)
<i>Festuca tenuifolia</i>		II (2)	
<i>Teesdalia nudicaulis</i>		II (1-3)	
<i>Sedum acre</i>			I (1)
<i>Plantago lanceolata</i>			I (3)
<i>Cerastium diffusum</i>			I (1)
<i>Poa compressa</i>		I (1)	
<i>Sonchus arvensis</i>		I (1)	
<i>Hieracium pilosella</i>			I (2)
<i>Armeria maritima</i>			I (2)
<i>Evernia prunastri</i>			I (1)
<i>Cladonia rangiformis</i>			I (3)
<i>Cladonia furcata</i>		I (2)	I (3)
<i>Rumex acetosella</i>		I (1)	
<i>Coelocaulon aculeata</i>			I (1)
<i>Cladonia ciliata</i>		I (1)	
<i>Cladonia portentosa</i>		I (1)	I (1)
<i>Sedum anglicum</i>		I (3)	I (9)
<i>Cladonia squamosa</i>		I (1)	
<i>Cladonia macilenta</i>			I (1)
<i>Cladonia subulata</i>			I (1)
<i>Xanthoria parietina</i>			I (1)
<i>Vicia lutea</i>		I (1)	I (2)
<i>Cladonia crispata</i>		I (1)	
<i>Cladonia polydactyla</i>		I (1)	
<i>Lophocolea heterophylla</i>		I (1)	
<i>Barbula cylindrica</i>		I (1)	

	1	2	3
Lophocolea cuspidata		I (1)	
Tortula muralis			I (3)
Senecio vulgaris			I (1)
Crepis viscaria			I (1)
Crambe maritima			II (1)
No of samples	85	8	12
No of species/sample	12(4-19)	14(6-24)	11(5-17)

LIST 8. C (pert) strandline vegetation compared with NVC/S03: *Atriplex hastata*-
Beta vulgaris subsp. *maritima* strandline vegetation.

- 1 NVC/S03: *Atriplex hastata*-*Beta vulgaris* subsp. *maritima* strandline
 2 Dungeness C (1)

	1	2
<i>Beta vulgaris</i>		
subsp. <i>maritima</i>	V (1-7)	
<i>Atriplex hastata</i>	IV (2-8)	
<i>Festuca rubra</i>	III (1-9)	
<i>Metridaria maritima</i>	III (1-7)	
<i>Rumex crispus</i>	II (2-5)	
<i>Elymus repens</i>	II (2-8)	
<i>Carex arenaria</i>	II (1-6)	
<i>Sonchus arvensis</i>	II (2-5)	
<i>Hemionys perfoliatus</i>	I (3-4)	
<i>Crithmum maritimum</i>	I (2-5)	
<i>Plantago coronopus</i>	I (2-5)	
<i>Cochlearia danica</i>	I (2-4)	
<i>Glauclium flavum</i>	I (2-3)	
<i>Elymus pycnanthus</i>	I (2-6)	
<i>Plantago lanceolata</i>	I (2-3)	
<i>Euphorbia paralias</i>	I (3-4)	
<i>Amophila arenaria</i>	I (3-4)	
<i>Cirsium arvense</i>	I (2-4)	
<i>Stellaria media</i>	I (3)	
<i>Atriplex patula</i>	I (1)	
<i>Galium aparine</i>	I (1)	
<i>Armeria maritima</i>	I (2)	
<i>Silene vulgaris</i>		
subsp. <i>maritima</i>	I (1-5)	
<i>Melilotus officinalis</i>	I (4-5)	
<i>Cirsium vulgare</i>	I (1-4)	
<i>Elymus farctus</i>	I (1-3)	
<i>Atriplex laciniata</i>	I (3)	
<i>Atriplex littoralis</i>	I (2)	
<i>Leontodon taraxacoides</i>	I (1-2)	
<i>Sagina apetala</i> subsp. <i>erecta</i>	I (1-4)	
<i>Senecio viscosus</i>	I (2-3)	
<i>Solanum dulcamara</i>	I (2-4)	
<i>Euphorbia portlandica</i>	I (2)	
<i>Daucus carota</i>	I (3)	
<i>Medicago lupulina</i>	I (2)	
<i>Rumex rupestris</i>	I (3)	
<i>Althaea officinalis</i>	I (4)	
<i>Atriplex glabriuscula</i>		V (3-4)
No. of samples	25	3
No. of species/sample	7(2-17)	1

LIST 9. C (part) strandline vegetation compared with RVC/SD1: *Crambe maritima*-*Glaucium flavum* strandline community.

- 1 RVC/SD1: *Crambe maritima*-*Glaucium flavum* shingle community
- 2 Dungeness C (ii)
- 3 Dungeness C (iii)

	1	2	3
<i>Crambe maritima</i>	IV (1-8)	V (2)	V (4-5)
<i>Glaucium flavum</i>	IV (1-5)		
<i>Rumex crispus</i>	III (1-5)	V (1-3)	III (1)
<i>Atriplex hastata</i>	II (1-5)		
<i>Geta vulgaris</i>			
subsp. <i>maritima</i>	II (1-4)		
<i>Silene vulgaris</i>			
subsp. <i>maritima</i>	II (1-6)		
<i>Solanum dulcamara</i>	II (1-9)	III (2)	
<i>Arrhenatherum elatius</i>	II (1-7)	V (5-6)	
<i>Festuca rubra</i>	II (1-4)		
<i>Elymus pycnanthus</i>	I (2-3)		
<i>Cirsium arvense</i>	I (1-3)		
<i>Galium mollugo</i>	I (2-4)	III (1)	
<i>Hemionys peploides</i>	I (3-5)		
<i>Plantago lanceolata</i>	I (1-4)		
<i>Sedum acre</i>	I (2-4)		
<i>Senecio jacobaea</i>	I (1-2)		
<i>Senecio vulgaris</i>	I (1-3)		
<i>Sonchus arvensis</i>	I (1-2)		
<i>Matricaria maritima</i>	I (1-5)		
<i>Lathyrus japonica</i>	I (2-6)	III (3)	
<i>Potentilla anserina</i>	I (2)		
<i>Elymus farctus</i>	I (3-5)		
<i>Echium vulgare</i>	I (1-2)		
<i>Malva sylvestris</i>	I (1-2)		
<i>Senecio viscosus</i>	I (2-4)		II (1)
<i>Sonchus asper</i>	I (1-2)		
<i>Taraxacum officinale</i> agg.	I (2)		
<i>Atriplex glabriuscula</i>			II (3)
No of samples	25	2	4
No of species/sample	7(2-17)	4(3-6)	2(1-3)

LIST 10. G *Geranium robertianum* community.

1 Dungeness G

1

<i>Geranium robertianum</i>	V (2-4)
<i>Festuca rubra</i>	III (1-8)
<i>Arrhenatherum elatius</i>	II (6)
<i>Vicia sativa</i>	II (3)
<i>Cerastium fontanum</i>	II (2)
<i>Hypnum cupressiform</i> var.	
<i>cupressiforme</i>	II (1)
<i>Silene vulgaris</i> subsp. <i>maritima</i>	II (2)
No of samples	4
No of species/sample	3(1-6)

LIST 11. I *Ilex aquifolium* community.

1 Dungeness I

	1
<i>Ilex aquifolium</i>	V (10)
<i>Rubus fruticosus</i> agg.	V (1-2)
<i>Sambucus nigra</i>	V (2-4)
<i>Corydalis claviculata</i>	V (2-4)
<i>Teucrium scorodonia</i>	V (3-4)
<i>Lecanora conizaeoides</i>	V (3)
<i>Solanum dulcamara</i>	IV (1)
<i>Xanthoria parietina</i>	IV (1-3)
<i>Ramalina farinacea</i>	III (1-2)
<i>Lonicera periclymenum</i>	II (1)
<i>Poa annua</i>	II (1)
<i>Brachythecium rutabulum</i>	II (1)
<i>Parmelia perlata</i>	II (1)
<i>Parmelia sulcata</i>	II (2)
<i>Evernia prunastri</i>	II (3)
<i>Hypogymnia physodes</i>	II (2)
No of samples	4
No of species/sample	10(9-12)

LIST 12. E *Sambucus nigra* community.

1 Dungeness E

	1
<i>Sambucus nigra</i> seedlings	IV (3-4)
<i>Urtica dioica</i>	IV (1-5)
<i>Teucrium scorodonia</i>	V (3-6)
<i>Hypnum cupressiforme</i> var. <i>lacunosum</i>	III (3)
<i>Eurhynchium praelongum</i>	IV (3)
<i>Brachythecium rutabulum</i>	IV (1-3)
<i>Ceratodon purpureus</i>	I (2)
<i>Stellaria media</i>	I (2)
<i>Dryopteris dilatata</i>	I (2)
<i>Holcus lanatus</i>	II (1-5)
<i>Senecio viscosus</i>	I (3)
<i>Corydalis claviculata</i>	I (3)
<i>Rubus fruticosus</i> agg.	I (4)
<i>Sedum anglicum</i>	III (1-3)
<i>Bryum capillare</i>	I (1)
<i>Xanthoria parietina</i>	III (1-3)
<i>Diploicia canescens</i>	III (1-3)
<i>Physcia tenella</i>	III (1-3)
<i>Lecanora confusa</i>	III (3)
<i>Suella punctata</i>	III (3)
No of samples	4
No of species/sample	10(7-15)

LIST 13. *R. Prunus spinosa* community.

1. Dungeness P.

1

<i>Prunus spinosa</i>	IV (5-9)
<i>Hypogymnia physodes</i>	V (3-4)
<i>Cladonia rangiformis</i>	V (1-3)
<i>Cladonia furcata</i>	V (1-2)
<i>Cladonia ciliata</i>	V (1-5)
<i>Evernia prunastri</i>	IV (3-4)
<i>Lecanora confusa</i>	IV (3)
<i>Ulex subfloridus</i>	IV (1-3)
<i>Parmelia glabratula</i>	IV (3)
<i>Hypogymnia tubulosa</i>	IV (1-2)
<i>Archonothium elatius</i>	III (1-3)
<i>Festuca rubra</i>	III (3)
<i>Silene vulgaris</i>	
subsp. <i>maritima</i>	III (5-6)
<i>Parmelia sulcata</i>	III (1-2)
<i>Anthoxanthum odoratum</i>	III (3-4)
<i>Dicranum scoparium</i>	III (2-5)
<i>Hypnum cupressiforme</i> var.	
<i>cupressiforme</i>	III (2-3)
<i>Coclocaulon scolopata</i>	III (1-3)
<i>Vicia sativa</i>	II (1-2)
<i>Rumex acetosa</i>	II (3)
<i>Cardamine hirsuta</i>	II (1-2)
<i>Teucrium scorodonia</i>	II (5)
<i>Cladonia portentosa</i>	II (1-2)
<i>Sedum anglicum</i>	II (2-3)
<i>Parmeliopsis aleurites</i>	II (1)
<i>Parmelia caperata</i>	II (1-3)
<i>Frullania tamarisci</i>	II (1-3)
<i>Rumex crispus</i>	I (2)
<i>Hypnum cupressiforme</i> var.	
<i>lacunosum</i>	I (2)
<i>Bryum capillare</i>	I (2)
<i>Eurhynchium praelongum</i>	I (1)
<i>Corydalis claviculata</i>	I (3)
<i>Autocornium androgynum</i>	I (1)
<i>Cladonia chlorophaea</i> agg.	I (1)
<i>Cladonia gracilis</i>	I (2)
<i>Teesdalia nudicaulis</i>	I (2)
<i>Cladonia macilenta</i>	I (1-3)
<i>Xanthoria parietina</i>	I (1)
<i>Peltigera canina</i>	I (1)
<i>Dicranoweisia cirrata</i>	I (1)
<i>Graphis elegans</i>	I (1)

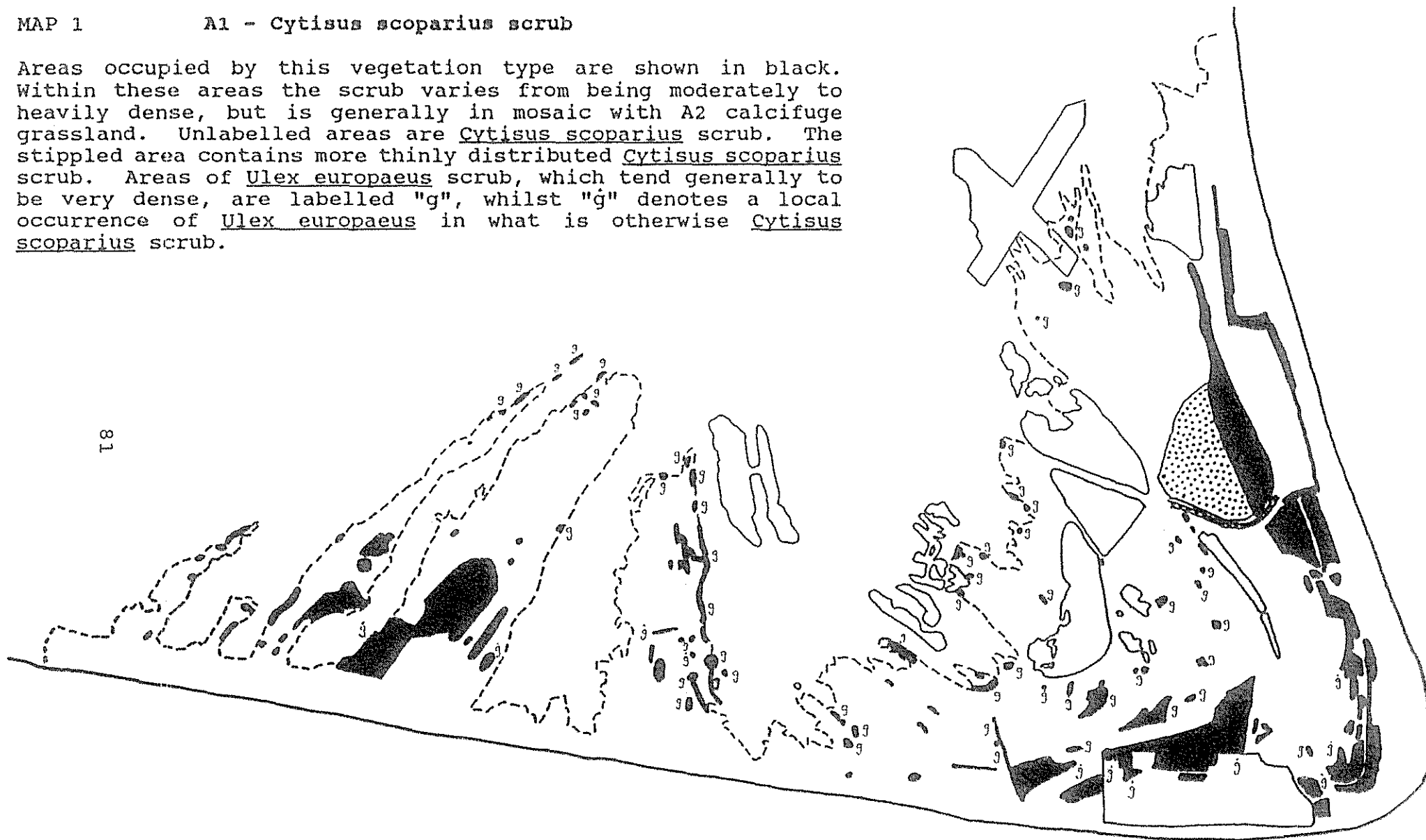
No of samples 7
No of species/sample 18(10-32)

APPENDIX 2
MAPS 1 TO 12
and

EXAMPLE OF A 1:2,500 MAP (FULLER 1989)

Maps 1 to 12 (approximately 1:40,000) are intended to provide a guide to the distributions of vegetation types described in this report. They were generated from the field maps used in the production of the 1:2,500 vegetation maps (Fuller 1989), published under separate contract (see p. 13 for further details).

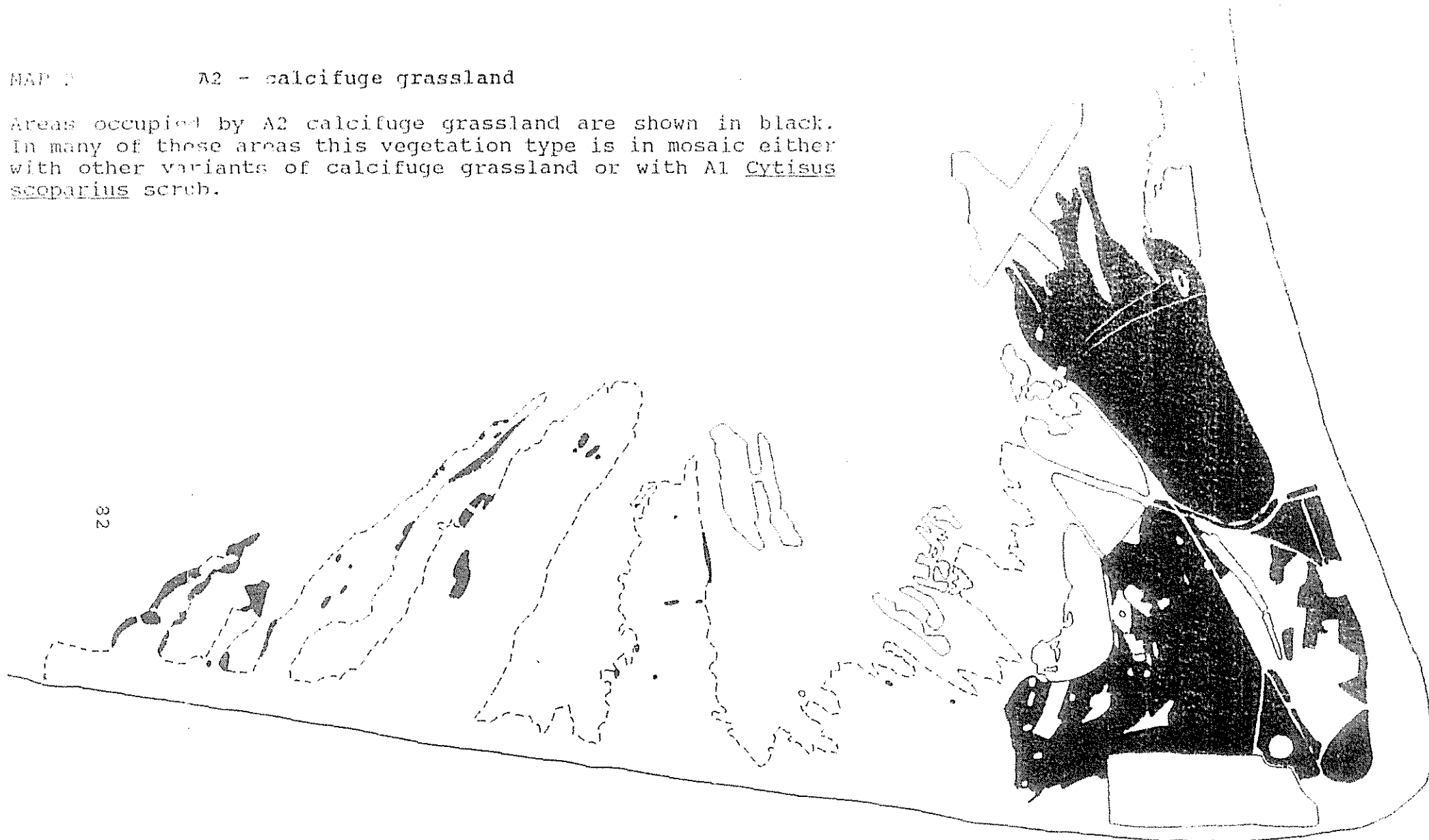
Areas occupied by this vegetation type are shown in black. Within these areas the scrub varies from being moderately to heavily dense, but is generally in mosaic with A2 calcifuge grassland. Unlabelled areas are *Cytisus scoparius* scrub. The stippled area contains more thinly distributed *Cytisus scoparius* scrub. Areas of *Ulex europaeus* scrub, which tend generally to be very dense, are labelled "g", whilst "g" denotes a local occurrence of *Ulex europaeus* in what is otherwise *Cytisus scoparius* scrub.



MAP 2

A2 - calcifuge grassland

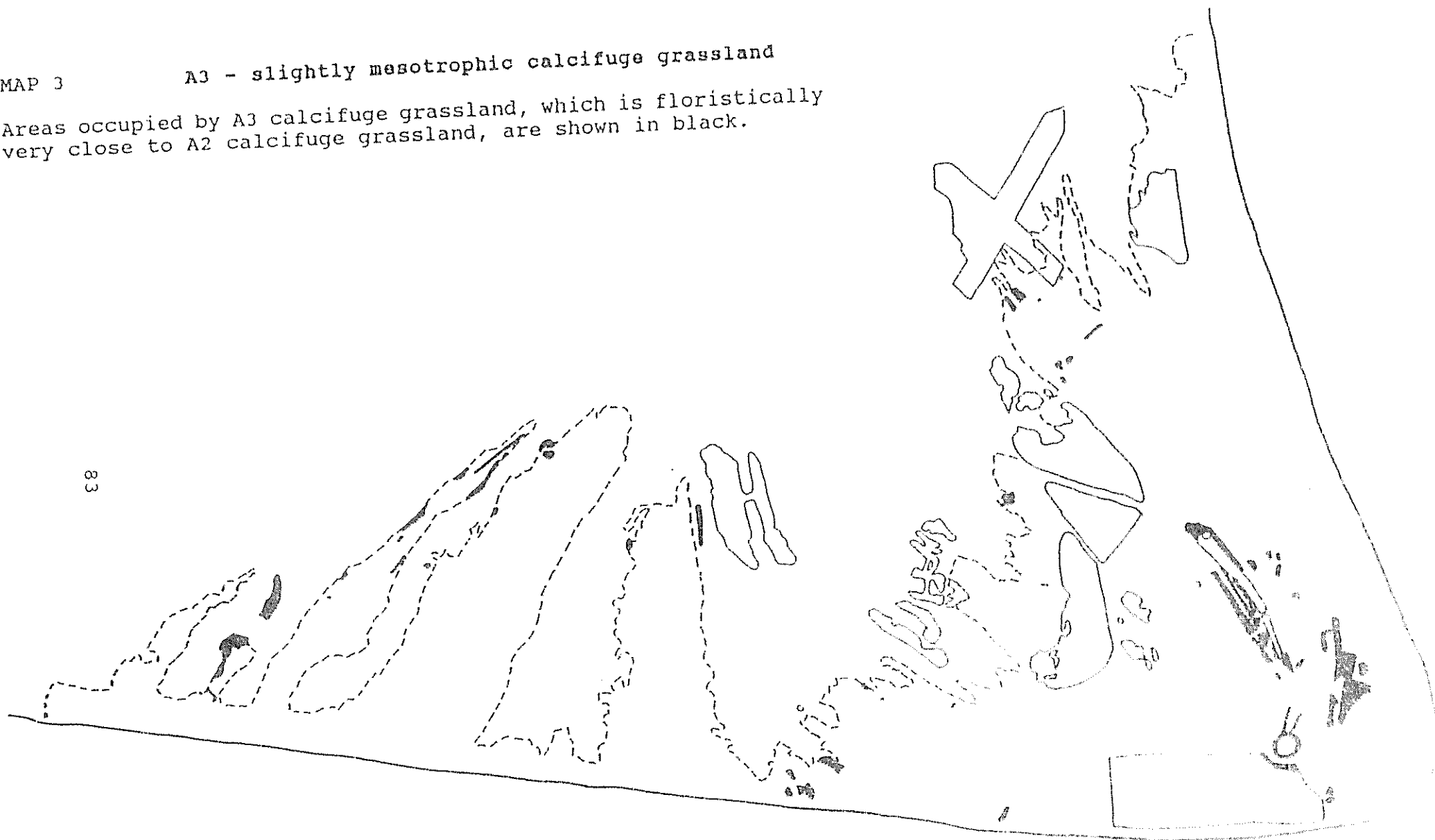
Areas occupied by A2 calcifuge grassland are shown in black. In many of these areas this vegetation type is in mosaic either with other variants of calcifuge grassland or with A1 Cytisus scoparius scrub.



MAP 3

A3 - slightly mesotrophic calcifuge grassland

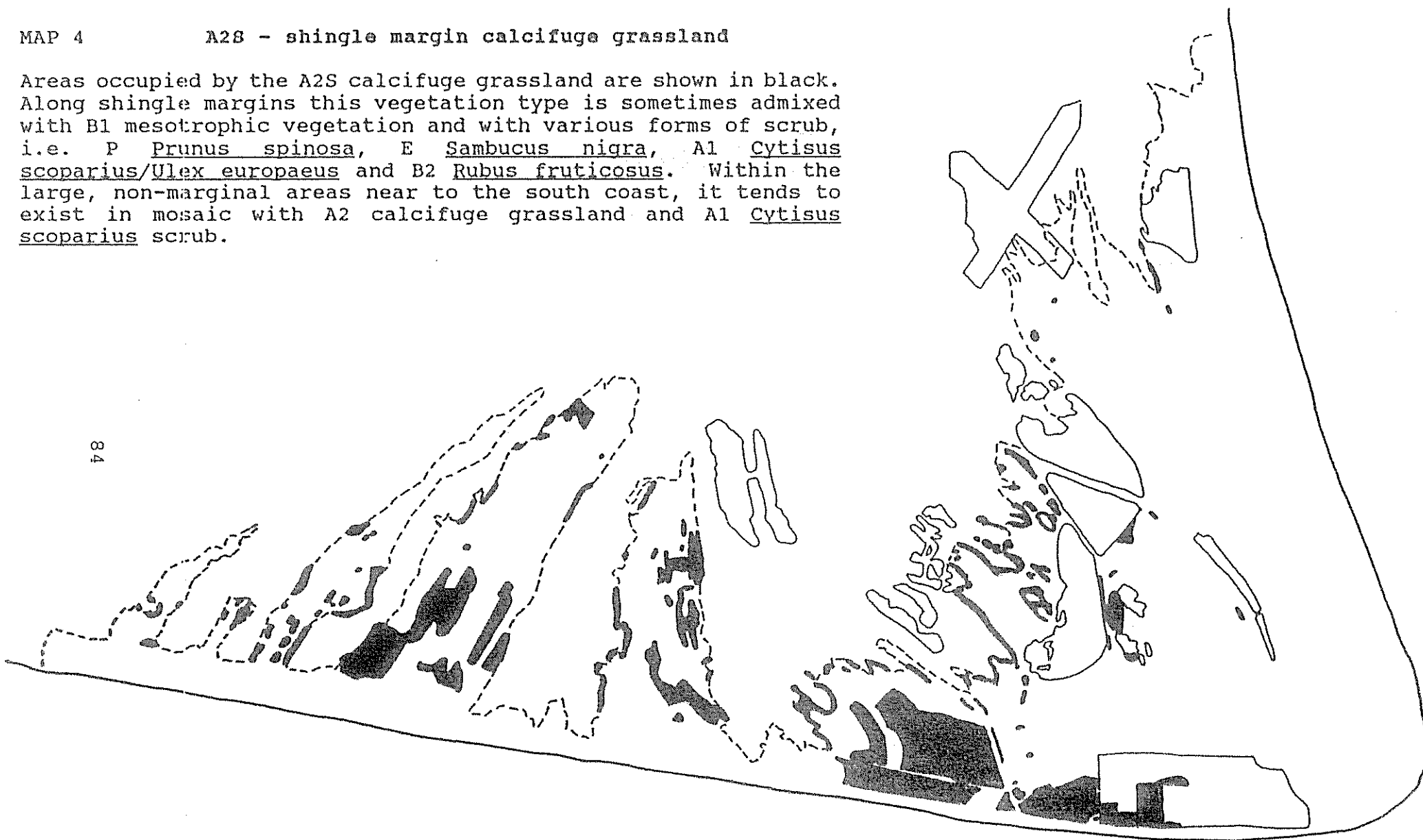
Areas occupied by A3 calcifuge grassland, which is floristically very close to A2 calcifuge grassland, are shown in black.



MAP 4

A28 - shingle margin calcifuge grassland

Areas occupied by the A2S calcifuge grassland are shown in black. Along shingle margins this vegetation type is sometimes admixed with B1 mesotrophic vegetation and with various forms of scrub, i.e. P Prunus spinosa, E Sambucus nigra, A1 Cytisus scoparius/Ulex europaeus and B2 Rubus fruticosus. Within the large, non-marginal areas near to the south coast, it tends to exist in mosaic with A2 calcifuge grassland and A1 Cytisus scoparius scrub.



A2F - *Festuca rubra* grassland

MAP 5 A2F - Festuca rubra grassland

Areas occupied by this vegetation type are shown in black. Generally, stands are fairly pure and are interrupted along the south coast by clearly demarcated, low-lying patches of saltmarsh vegetation. Vegetation type G - Geranium robertianum coincides very closely with this vegetation type.

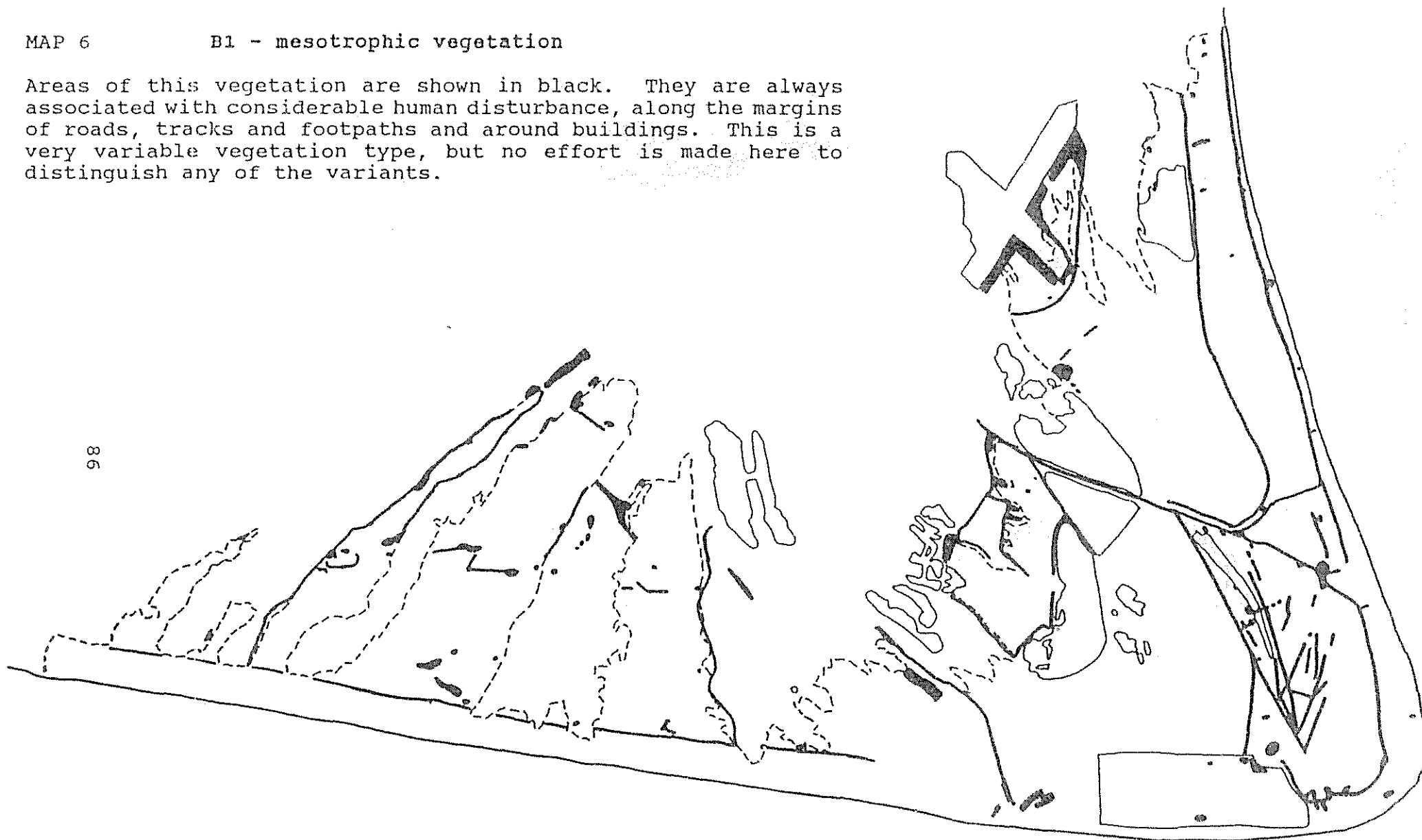
35

63
64

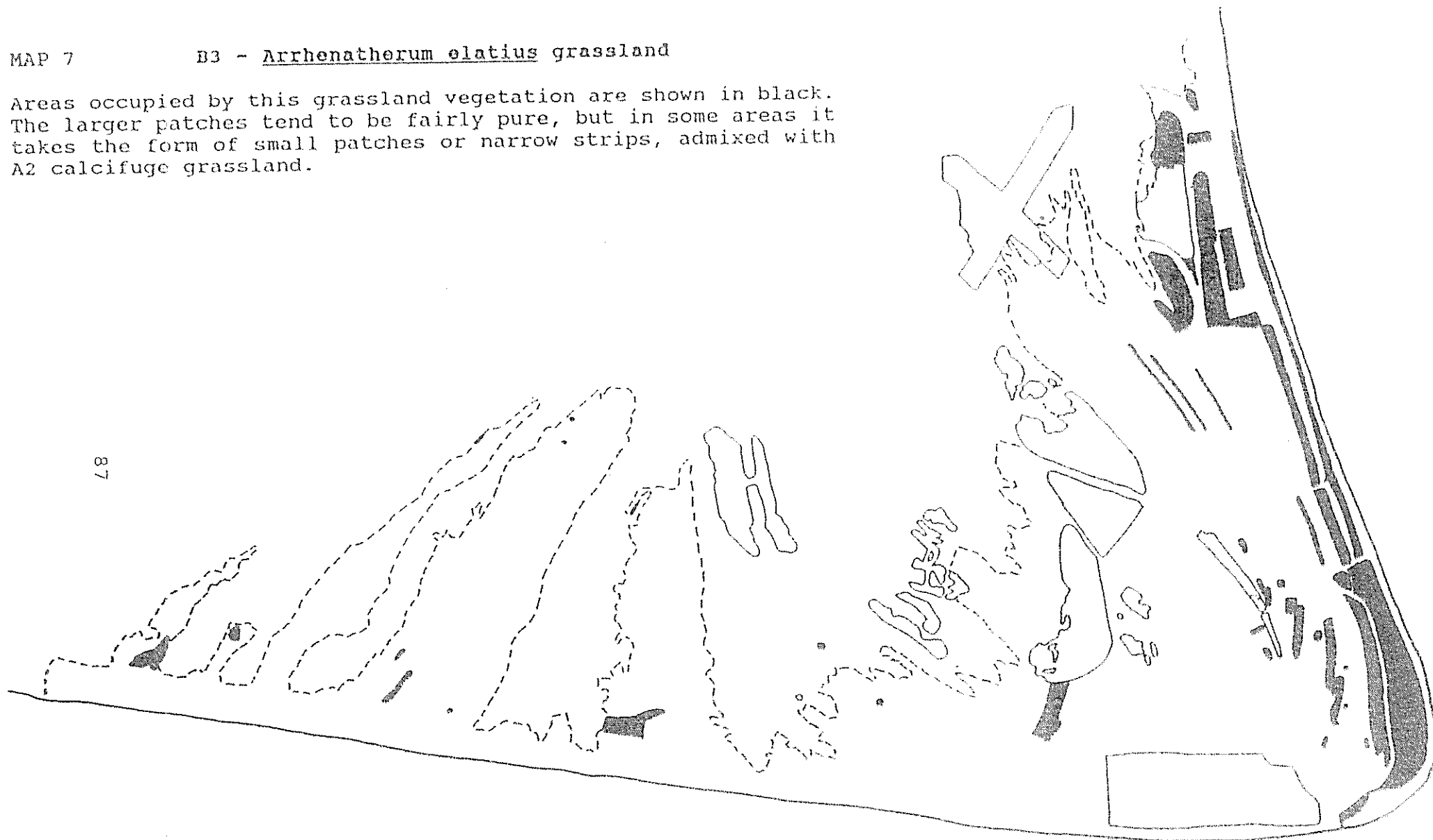
MAP 6

B1 - mesotrophic vegetation

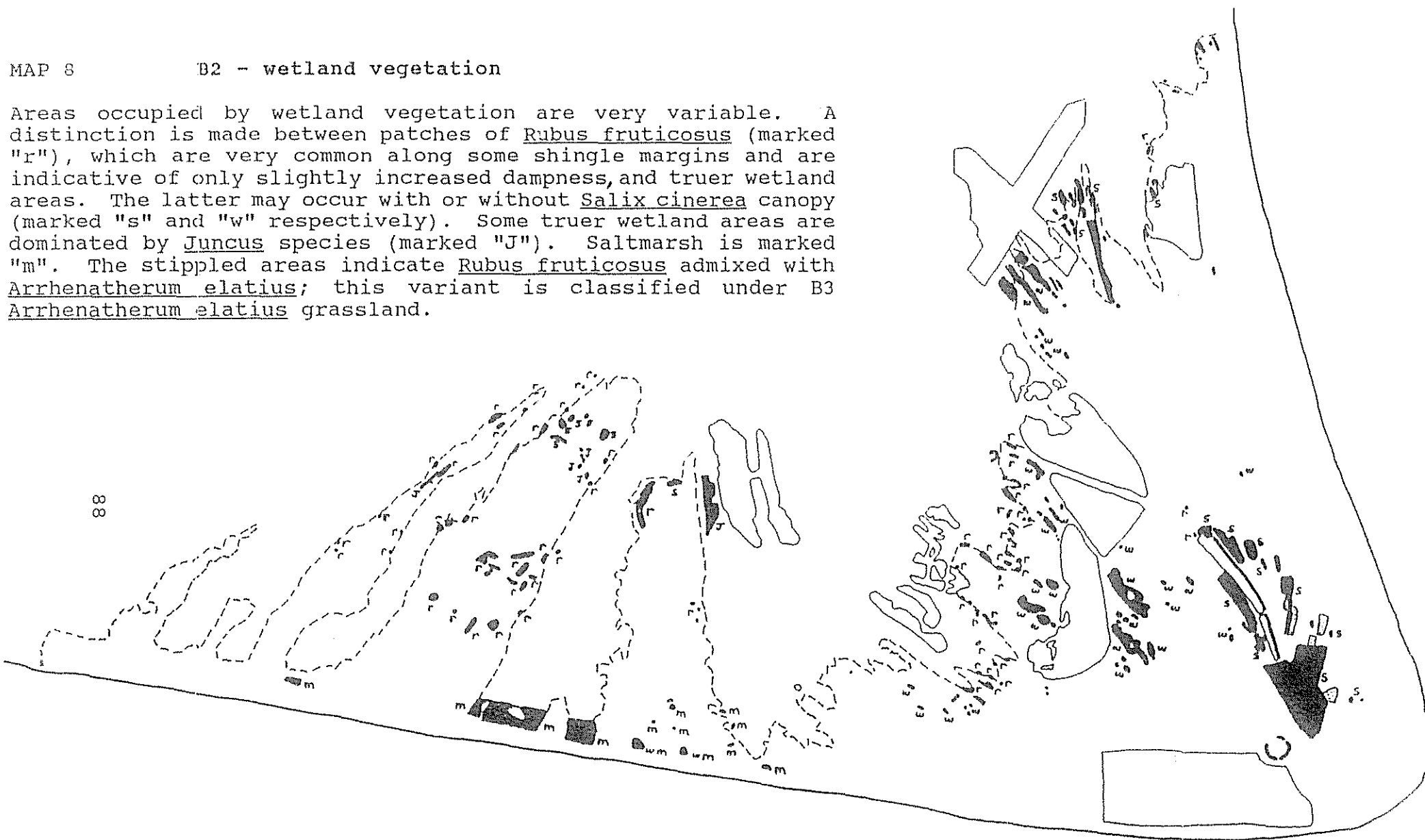
Areas of this vegetation are shown in black. They are always associated with considerable human disturbance, along the margins of roads, tracks and footpaths and around buildings. This is a very variable vegetation type, but no effort is made here to distinguish any of the variants.



Areas occupied by this grassland vegetation are shown in black. The larger patches tend to be fairly pure, but in some areas it takes the form of small patches or narrow strips, admixed with A2 calcifuge grassland.

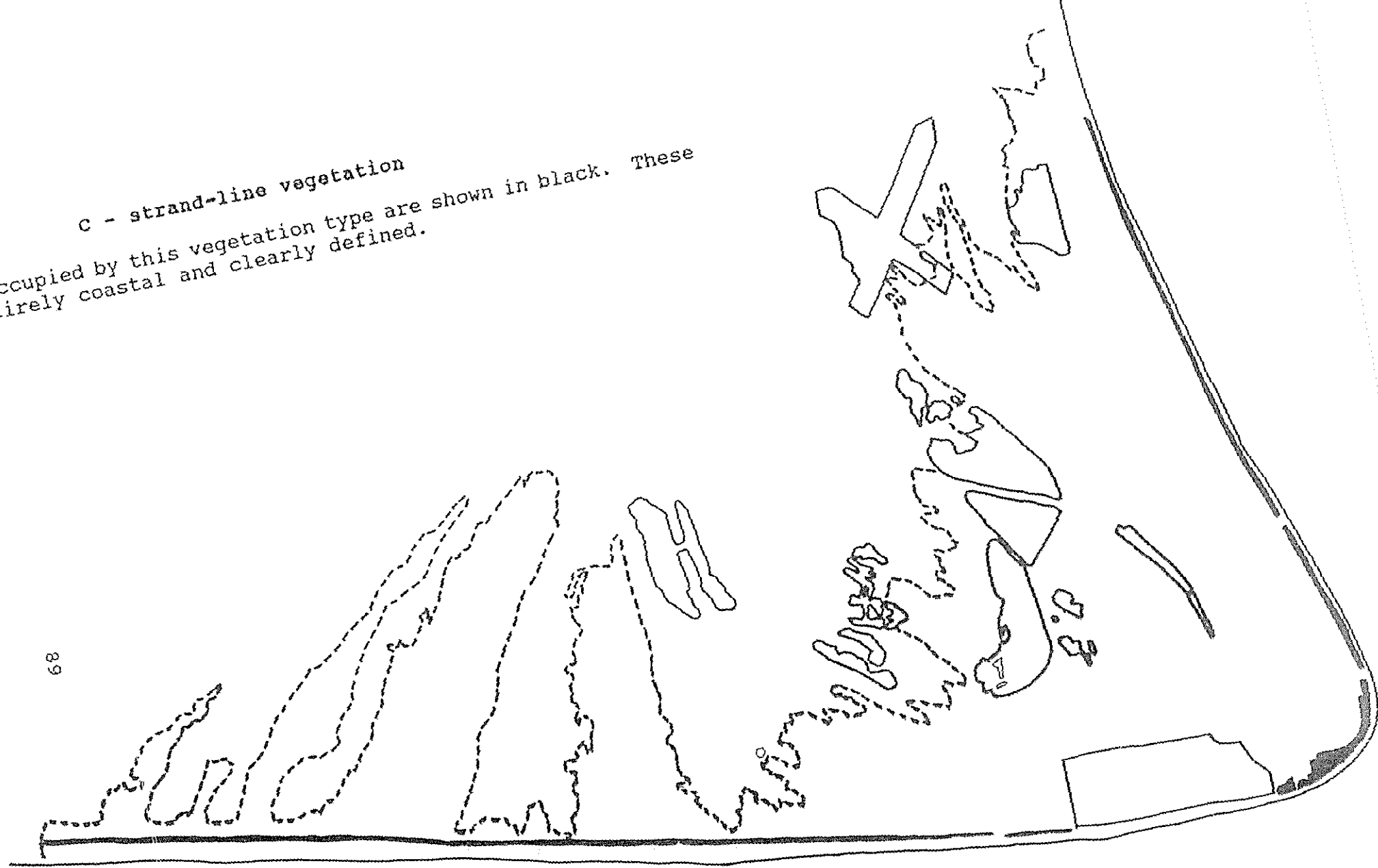


Areas occupied by wetland vegetation are very variable. A distinction is made between patches of Rubus fruticosus (marked "r"), which are very common along some shingle margins and are indicative of only slightly increased dampness, and truer wetland areas. The latter may occur with or without Salix cinerea canopy (marked "s" and "w" respectively). Some truer wetland areas are dominated by Juncus species (marked "J"). Saltmarsh is marked "m". The stippled areas indicate Rubus fruticosus admixed with Arrhenatherum elatius; this variant is classified under B3 Arrhenatherum elatius grassland.



MAP 9

c - strand-line vegetation
Areas occupied by this vegetation type are shown in black. These
are entirely coastal and clearly defined.

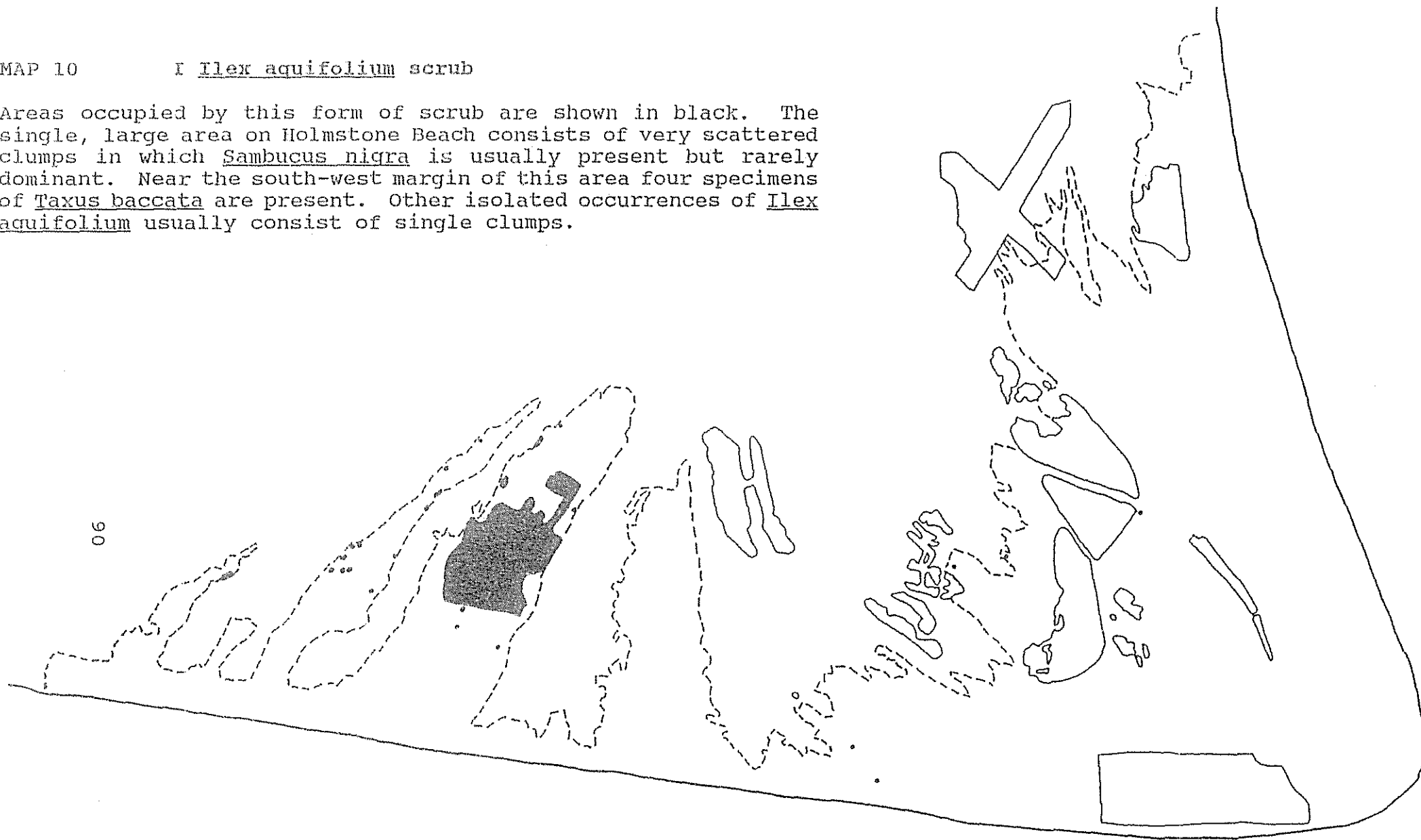


MAP 10

I Ilex aquifolium scrub

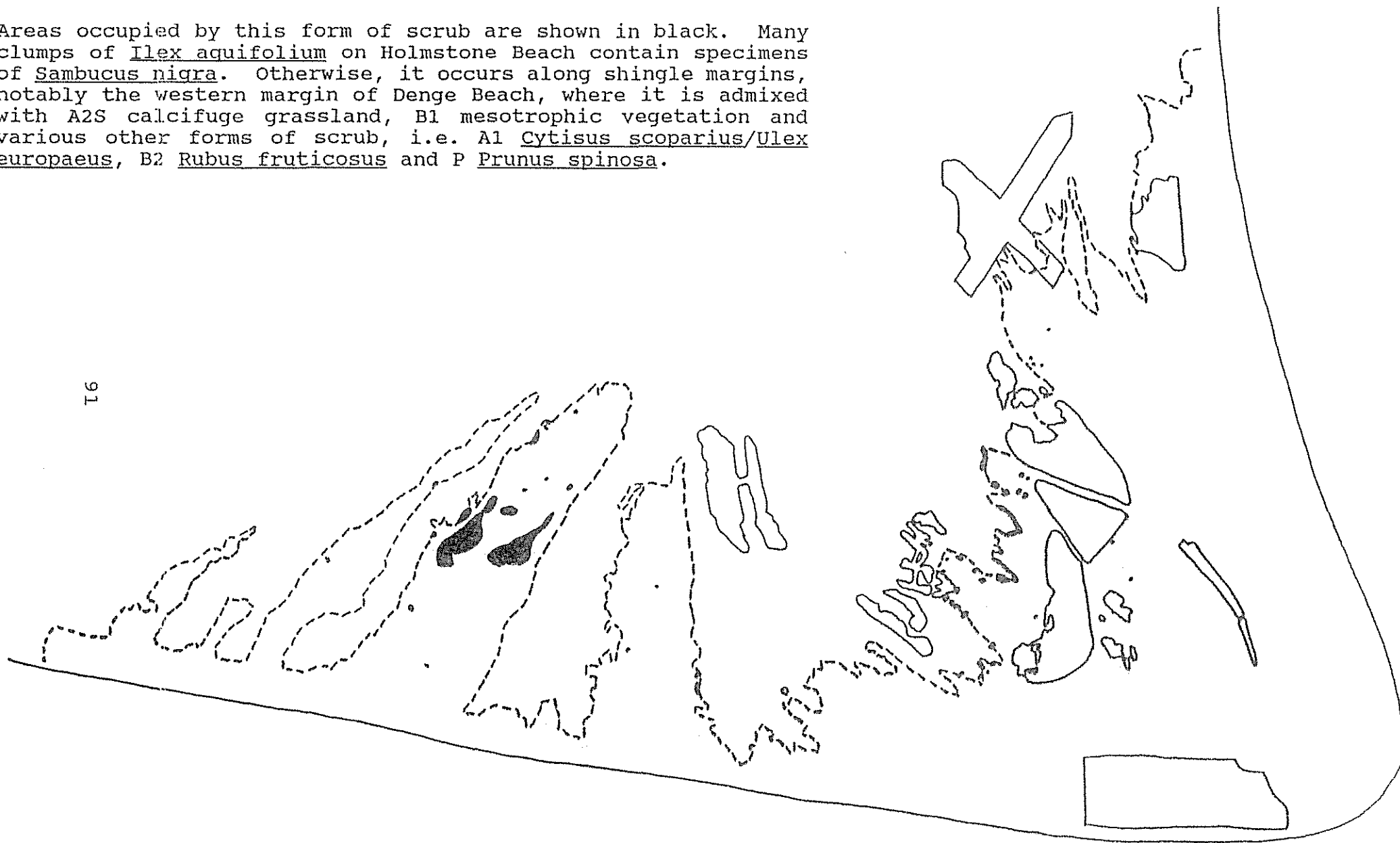
Areas occupied by this form of scrub are shown in black. The single, large area on Holmstone Beach consists of very scattered clumps in which Sambucus nigra is usually present but rarely dominant. Near the south-west margin of this area four specimens of Taxus baccata are present. Other isolated occurrences of Ilex aquifolium usually consist of single clumps.

06

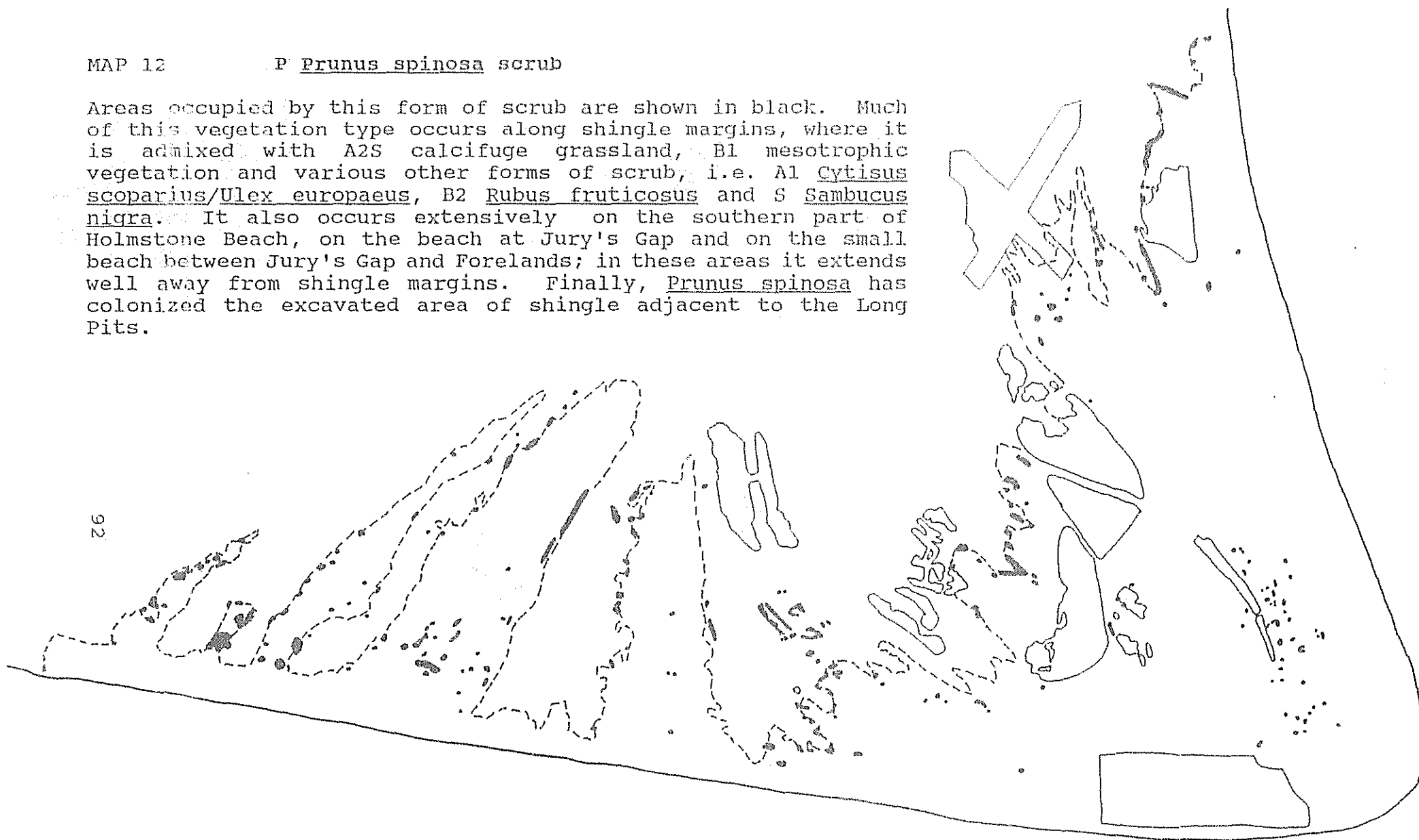


Areas occupied by this form of scrub are shown in black. Many clumps of Ilex aquifolium on Holmstone Beach contain specimens of Sambucus nigra. Otherwise, it occurs along shingle margins, notably the western margin of Denge Beach, where it is admixed with A2S calcifuge grassland, B1 mesotrophic vegetation and various other forms of scrub, i.e. A1 Cytisus scoparius/Ulex europaeus, B2 Rubus fruticosus and P Prunus spinosa.

16



Areas occupied by this form of scrub are shown in black. Much of this vegetation type occurs along shingle margins, where it is admixed with A2S calcifuge grassland, B1 mesotrophic vegetation and various other forms of scrub, i.e. A1 Cytisus scoparius/Ulex europaeus, B2 Rubus fruticosus and S Sambucus nigra. It also occurs extensively on the southern part of Holmstone Beach, on the beach at Jury's Gap and on the small beach between Jury's Gap and Forelands; in these areas it extends well away from shingle margins. Finally, Prunus spinosa has colonized the excavated area of shingle adjacent to the Long Pits.



Part of one of the series of maps of the Pacific Northwest
by Fuller (1939), with explanatory key.



	Built up
	Bare shingle
	A1 <u>Cytisus scoparius</u>
	A2 acid heath <u>Rumex acetosella</u> <u>Dicranum scoparium</u> <u>Cladonia ciliata</u> <u>Teucrium scorodonia</u> <u>Anthoxanthum odoratum</u> <u>Festuca tenuifolia</u>
	A2 _s <u>Silene maritima</u> <u>Cladonia gracilis</u> <u>Cladonia foliacea</u> version of A2
	A2 _f <u>Armeria maritima</u> <u>Silene maritima</u> (<u>Festuca rubra</u>)
	A3 modified acid heath slightly mesotrophic version <u>Cerastium fontanum</u> <u>Senecio jacobaea</u> <u>Teesdalia nudicaulis</u> <u>Sedum anglicum</u>
	B1 mesotrophic vegetation <u>Plantago lanceolata</u> <u>Poa compressa</u> <u>Senecio jacobaea</u>
	B2 wetland vegetation <u>Ranunculus repens</u> <u>Rubus fruticosus</u> <u>Galium palustre</u>
	B2 _s wetland vegetation with <u>Salix</u> sp.
	B3 <u>Arrhenatherum elatius</u> <u>Galium mollugo</u> <u>Senecio viscosus</u>
	C <u>Crambe maritima</u> <u>Atriplex glabriuscula</u>
	H Salt/brackish marsh
	P <u>Prunus spinosa</u>
	G <u>Geranium robertianum</u>
	U <u>Ulex europaeus</u>
	E <u>Sambucus nigra</u>
	I <u>Ilex aquifolium</u>
	IE <u>Ilex/Sambucus</u>
	W Water
	WR Water/reeds <u>Phragmites australis</u>
	X Non-shingle

Note: Where cover is sparse (see text) this is shown by letter symbols in italics.

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